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NAVAER 01-60JKE-502

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Handbook  
Maintenance Instructions  
*NAVY MODEL*  
FJ-4B  
AIRCRAFT

SECTION III  
HYDRAULIC SYSTEM

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## Introduction to SECTION III

THIS HANDBOOK IS ONE OF A SERIES OF TEN which contain instructions required by using activities for the maintenance of Model FJ-4B aircraft. These are systems type handbooks. Each system in the aircraft is covered completely in a particular handbook. This includes all hydraulic, pneumatic, mechanical and electrical portions of the system. This has been done in order to assist the mechanic in becoming familiar with and in maintaining all phases of each system.

The "Hydraulic System" handbook contains information for the maintenance of the utility hydraulic system. In addition, maintenance information is included for all systems which depend upon the hydraulic system for power. The flight control hydraulic systems are covered separately in Section II of these handbooks.

This handbook contains information necessary for the performance of class C and class D maintenance on those items of Contractor Furnished Equipment for which there are no separate handbooks. This handbook does not contain instructions for the overhaul of components. Such instructions are issued as separate handbooks of overhaul instructions for the individual components.

Instructions for the repair of aircraft structure are contained in the Handbook of Structural Repair (NAVAER 01-60JKD-503) for these aircraft.

Data necessary for obtaining replacement parts and for complete identification of parts are contained in the Illustrated Parts Breakdown (NAVAER 01-60JKD-504) for these aircraft.

Weight and Balance Data are found in the applicable AN 01-1B-40 handbook for each of these aircraft.

To identify and obtain these publications and handbooks covering separate items of equipment, refer to the Naval Aeronautic Publications Numerical Index (NAVAER 00-500).

BuAer Serial Numbers 139531 through 139555, 141444 through 141489 and 143493 through 143643 have been assigned to the FJ-4B. In addition, a lower case letter has been made a part of each serial number as it is painted on the aircraft. These lower case letters have been assigned to blocks of serial numbers as follows:

SERIAL NUMBER	LETTER
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# FJ-4B *Fury*



FJ-4B Airplane

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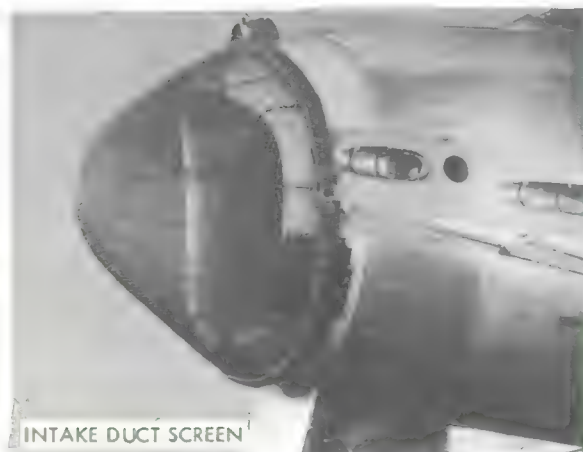


**Figure No. 3-1. Airplane Stations (Sheet 2)**

*Warning*

- Do not stand near the front of the air inlet duct while the engine is operating
- Always approach the airplane from the side but not in the plane of rotation of the turbine when the engine is running.
- Avoid wearing hats or other loose clothing when working in the run-up area.
- Do not carry loose articles such as pencils, key rings or tools when near the air inlet duct.
- Do not foolishly experiment with the margin of safety by standing near, or feeling with your hand, the suction created by the engine.
- Do not stand on wing of the airplane while engine is operating, unless assistance is required during cockpit check-out or functional check of equipment.
- The loudest sustained noise produced by man is the noise of a jet engine operating at high rpm. Jet-engine noise is dangerous to personnel working in the immediate area. At distances from 50 to 200 feet, wear ear plugs and at distances within a radius of 50 feet, wear ear plugs and a type of over-the-ear protector. Prolonged exposure to jet-engine noise can cause pain and damage to the inner ear. Other effects of prolonged exposure are fatigue, nervousness and impairment of hearing.
- Do not stand at the edge of the blast area as the temperature could suddenly increase with engine speeds.

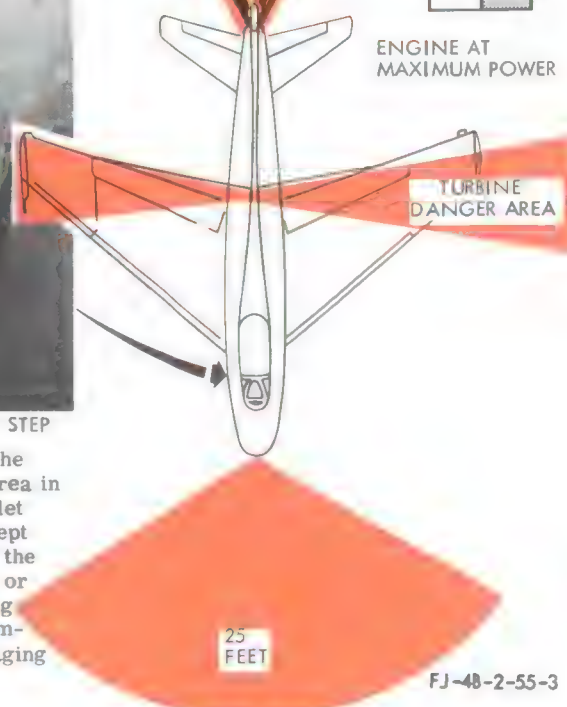
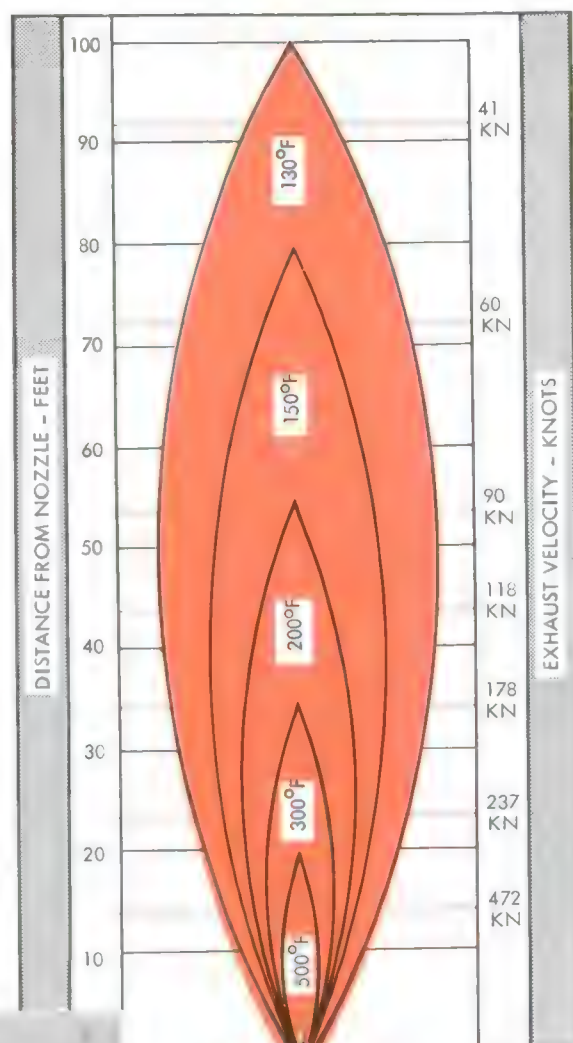
Place retaining rope hook in existing hole located in forward frame of step.



INTAKE DUCT SCREEN

ATTACH POINT AT STEP

**Caution** The area in front of the air inlet duct should be swept clean to minimize the possibility of dirt or other objects being drawn into the compressor and damaging the engine.



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Figure No. 3-2. Ground Run-up Danger Areas

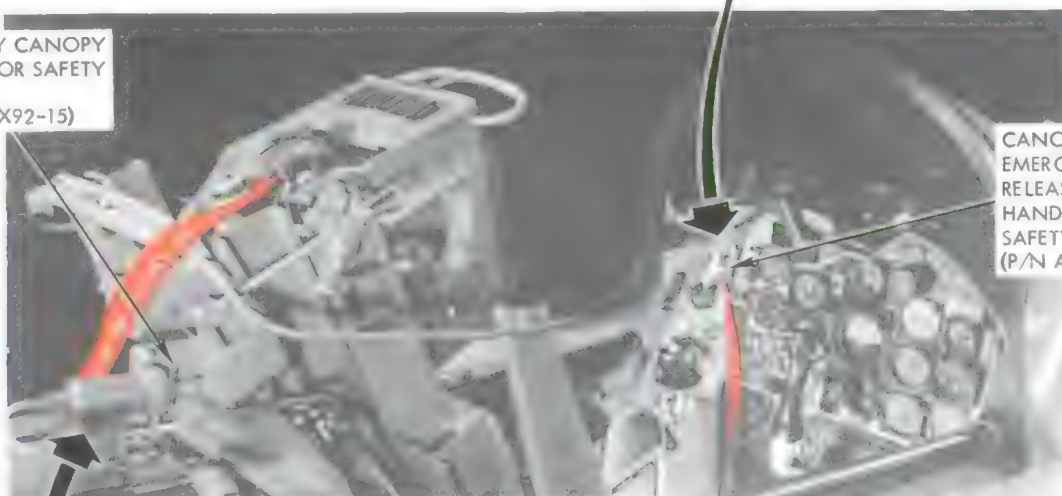


# *Warning*

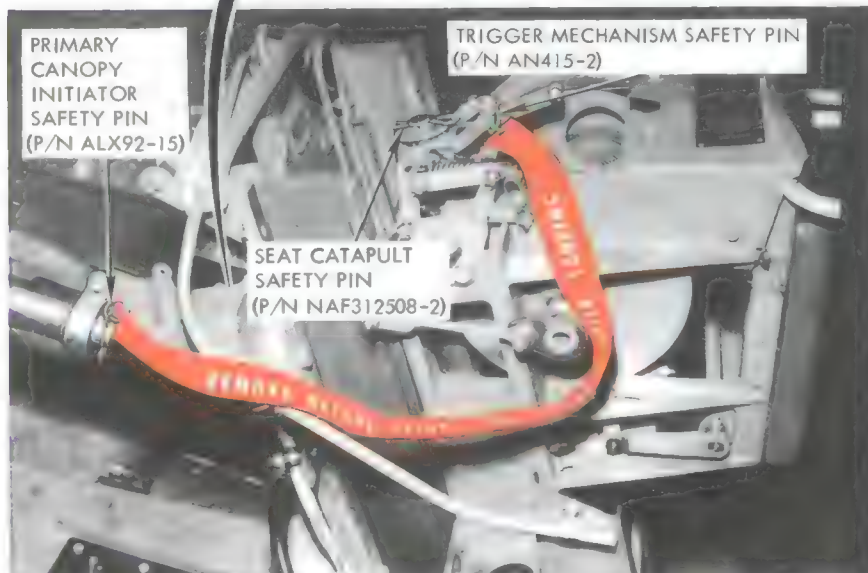
- Keep out of the cockpit unless maintenance is required.
- Always consider the emergency escape system loaded and armed.
- Know where the safety pins are and be certain of their installation.
- Do not manipulate linkage without full knowledge of the emergency escape system.
- Do not use linkage or handles as handgrips.
- The catapult cartridge, canopy remover, remover initiators and exactor are ordnance items and should be checked and maintained only by qualified personnel.



PRIMARY CANOPY  
INITIATOR SAFETY PIN  
(P/N ALX92-15)



CANOPY  
EMERGENCY  
RELEASE  
HANDLE  
SAFETY PIN  
(P/N ALX92-15)



PRIMARY  
CANOPY  
INITIATOR  
SAFETY PIN  
(P/N ALX92-15)

TRIGGER MECHANISM SAFETY PIN  
(P/N AN415-2)

SEAT CATAPULT  
SAFETY PIN  
(P/N NAF312508-2)

TRIGGER MECHANISM  
SAFETY ON

FJ-48-2-55-2

Figure No. 3-3. Emergency Escape System Ground Safety Pins



**Warning** Ground safety locks and pins are to be installed at all times, except for flight and gear retraction check. Remove immediately before flight and stow in cockpit map case.

A time-saving method for performing certain testing procedures on the airplane (which normally would require the use of ground jacks) may be accomplished by disabling the ground safety switch. Attach a red warning flag, similar to the flags used on the landing gear ground safety locks, whenever the ground safety switch is disabled.

**Warning** When a red warning flag has been attached to the ground safety switch to indicate a disabled switch, never remove flag from the unit until switch has been properly connected.

## GROUND SAFETY SWITCH



## NOSE LANDING GEAR GROUND SAFETY LOCK



**Note** There is no ground safety lock for the arresting gear.

## MAIN LANDING GEAR GROUND SAFETY LOCK

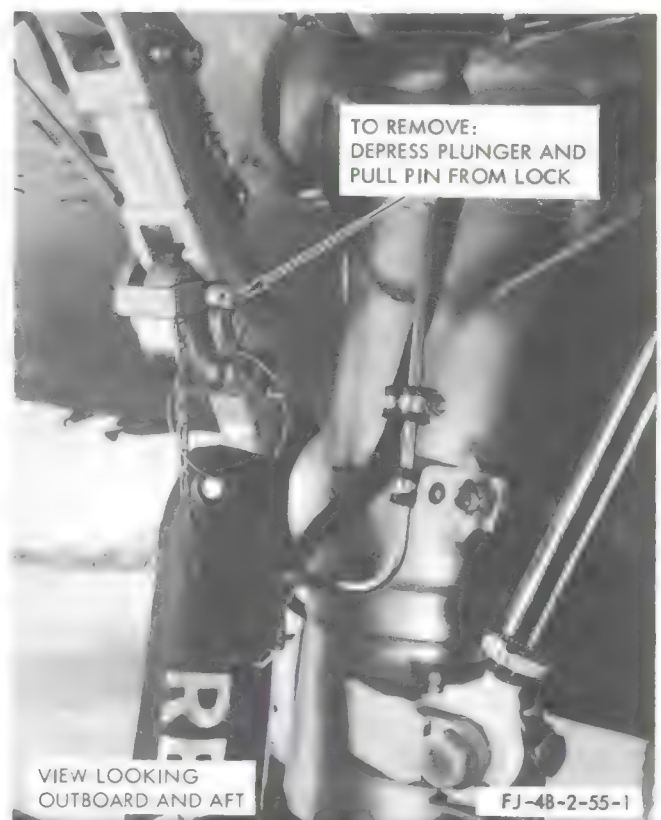


Figure No. 3-4. External Ground Safety Locks and Pins

**Section III**  
**General Information**

NAVAER 01-60JKE-502

To remove the pilot after a crash landing, proceed as follows.

- A. Remove canopy by using manual canopy release handle located on left-hand side of canopy frame above "RESCUE" marking. (If canopy is jammed, break glass with battering ax or tool.) Use extreme caution not to injure pilot.
- B. Open quick-release on seat belt (cut if necessary).
- C. Release parachute harness (cut if necessary).

D. Disconnect oxygen and radio cord, etc.

E. Carefully remove pilot.

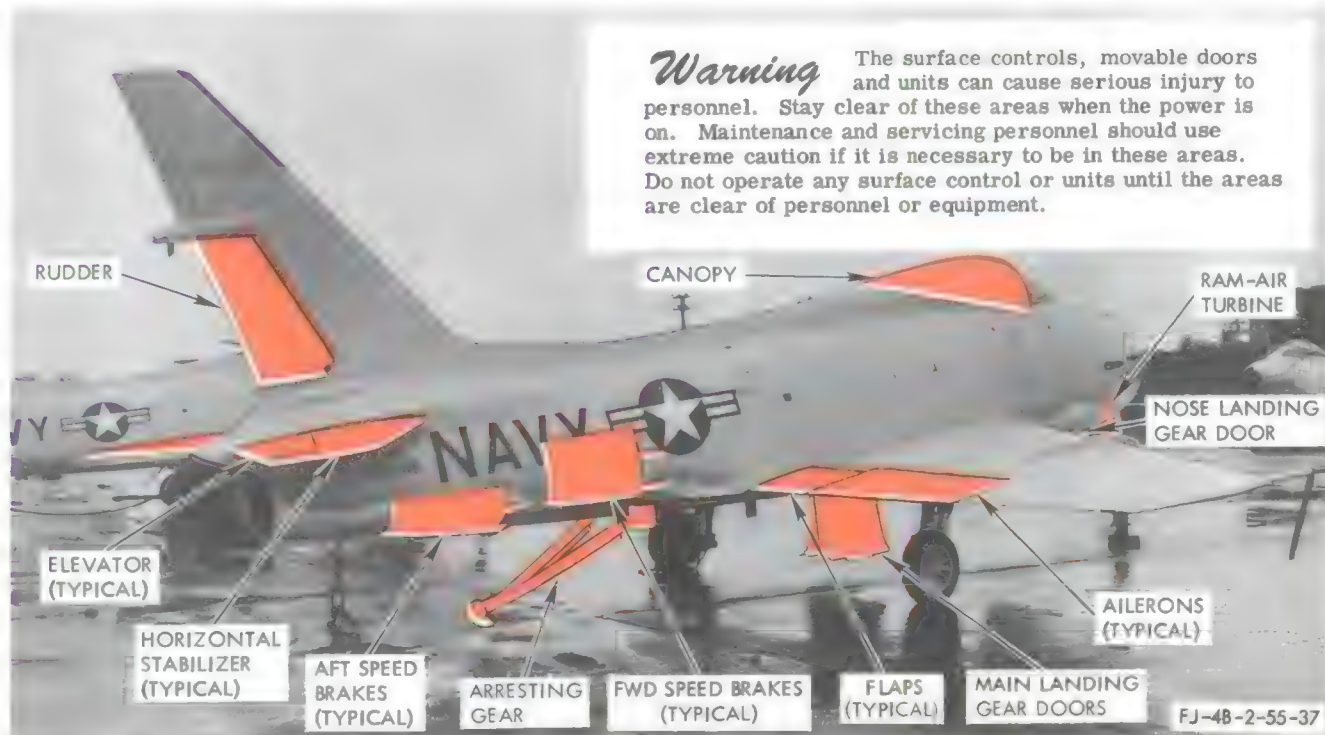
**Warning** Do not attempt to use the canopy release handle if the canopy is jammed.



FJ-4B-2-55-36

**Figure No. 3-5. Emergency Cockpit Entrance**

**Warning** The surface controls, movable doors and units can cause serious injury to personnel. Stay clear of these areas when the power is on. Maintenance and servicing personnel should use extreme caution if it is necessary to be in these areas. Do not operate any surface control or units until the areas are clear of personnel or equipment.



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**Figure No. 3-6. Movable Surface Hazards**

**HYDRAULIC FLUID.**

The hydraulic fluid used in this airplane conforms to item 95, materials list. When servicing the hydraulic system, make sure that only clean fluid is used. Never use fluid that has remained in an open container, regardless of how clean the fluid appears. Dirt and dust can be present without being evident. If impurities are admitted to the fluid, they will damage expensive units and cause the system to malfunction.

**HANDLING HYDRAULIC UNITS.**

Hydraulic units are designed to operate with close tolerances in all moving parts. Small particles of dirt or pieces of lint from cloths will cause the units to stick and will render the system inoperative. When hydraulic lines or units are removed, use clean caps and plugs to close openings. On units with flexible hydraulic hoses, do not use hoses as a convenient handle for picking up the part.

**Note**

Do not use cloths to plug lines or ports. When a hydraulic unit is removed from the airplane for any length of time, the unit should be flushed with preservative oil (item 96, materials list) and drip drained before caps and plugs are installed.

**HYDRAULIC QUICK-DISCONNECT COUPLINGS.**

Hydraulic quick-disconnect couplings of the self-sealing type (Aeroquip series) are used in the utility hydraulic system where frequent uncoupling of hydraulic lines is required. Each unit coupling consists of two self-sealing halves, thus making possible the separation and reconnection of hydraulic lines without loss of fluid or introduction of air into the system. Disconnecting or connecting the halves of a coupling can be performed by hand in a few seconds. When connected, these couplings are held in place by a union nut and lockspring. The union nut has a quick lead thread which allows for separation or connection of the coupling by one complete turn of the nut. The only function of the nut is to hold the halves together. One half of the unit normally has a flange plate for mounting; however, the unit can also be installed through a bulkhead fitting.

**CONNECTING AND TIGHTENING HYDRAULIC QUICK-DISCONNECT COUPLINGS.** All parts referred to may be identified in figure 3-8. The two halves of the couplings may be connected by placing the head of the tubular valve within the protruding nose of the mating half and rotating the nut in the clockwise direction. The union nut must then be tightened until its teeth fully engage the lockspring assembly and the nut is fully rotated. A properly tightened coupling will have compressed the lockspring assembly until a 1/16-inch minimum gap exists between the inside lip of the spring retainer fingers and the spring plate. When completely tightened, the outside nut may be easily removed with thumb and forefinger.

**Note**

Do not use a wrench to couple or uncouple hydraulic quick-disconnect fittings that incorporate an unmodified union nut. Modified union nuts may be identified by a letter "C" preceding the part number of the nut. On these union nuts, a wrench may be used to assist in tightening the coupling.

**INSTALLING FLEXIBLE HOSES HAVING AN FITTINGS.** To install flexible hoses having AN fittings, proceed as follows:

- a. Lubricate male threads of fitting sparingly with petrolatum (item 100, materials list).

**CAUTION**

Absolutely no compound should be applied or allowed to remain on end of fitting where it could enter the system and cause malfunctions.

- b. Using fingers, start "B" nut on fitting and turn until nut is finger-tight.

**Note**

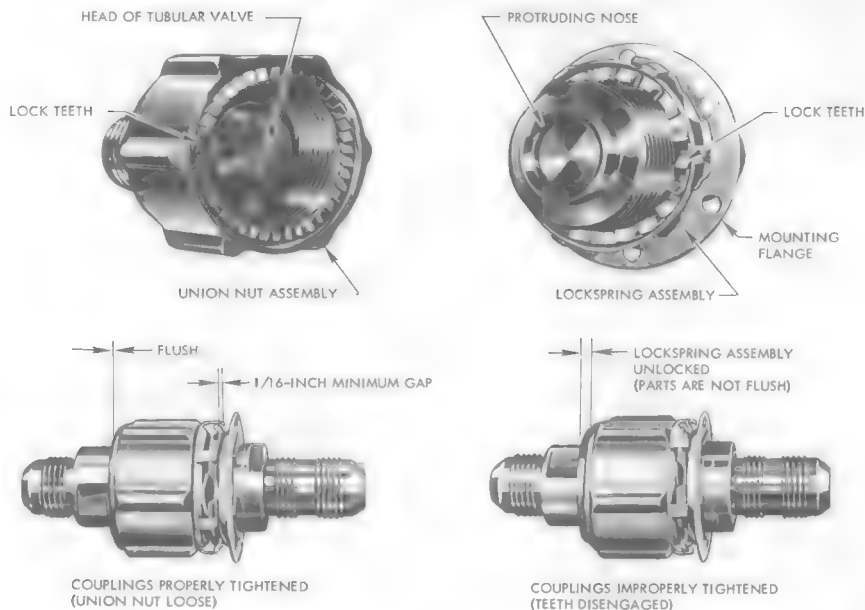
Never use wrench until "B" nut is finger-tight.

- c. Use torque wrench to tighten nut to specified torque. (See figure 3-7.) At the same time, hold the hexagon body of fitting to prevent fitting from turning.
- d. Make sure hose is not twisted and tighten "B" nut on other end in the same manner.

NOMINAL HOSE SIZE (INCHES)	"AN" FLEXIBLE HOSE ASSEMBLIES	
	INCH-POUNDS (MINIMUM)	INCH-POUNDS (MAXIMUM)
1/8		
3/16	30	70
1/4	70	120
5/16	70	120
3/8	130	180
1/2	300	400
5/8	430	550
3/4	650	800
1	900	1100
1-1/4	1200	1450
1-1/2	1550	1850
1-3/4	2000	2350
2	2500	2900

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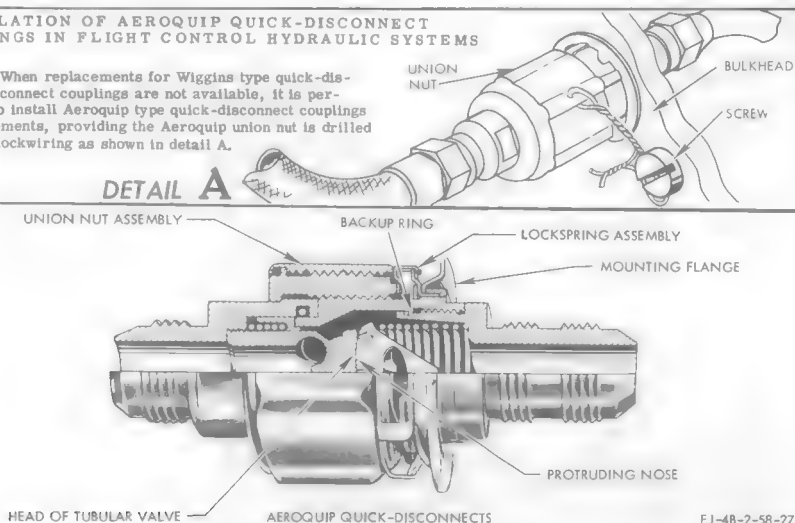
Figure No. 3-7. AN Flex Hose Torque Values



INSTALLATION OF AEROQUIP QUICK-DISCONNECT COUPLINGS IN FLIGHT CONTROL HYDRAULIC SYSTEMS

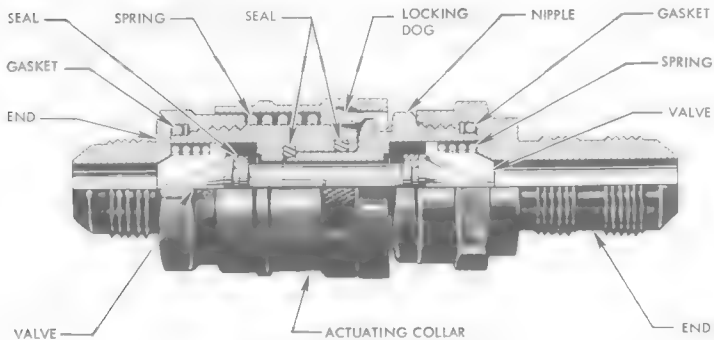
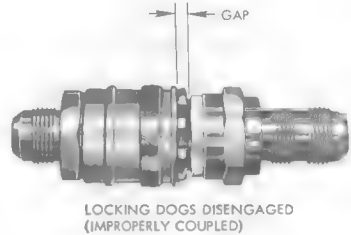
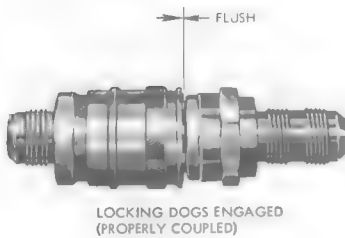
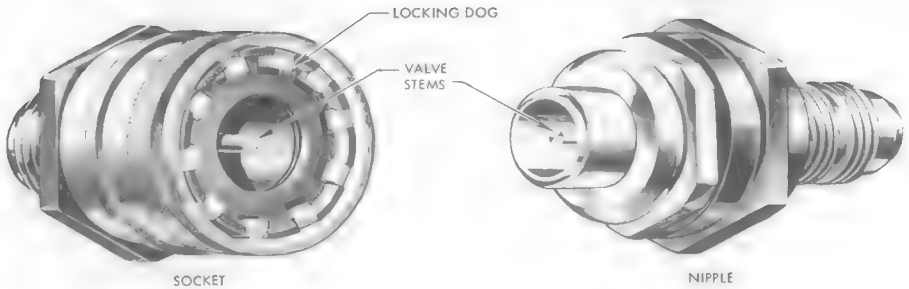
**Note** When replacements for Wiggins type quick-disconnect couplings are not available, it is permissible to install Aeroquip type quick-disconnect couplings as replacements, providing the Aeroquip union nut is drilled to permit lockwiring as shown in detail A.

**DETAIL A**



FJ-4B-2-58-27A

Figure No. 3-8. Hydraulic Quick-disconnect Couplings (Sheet 1)

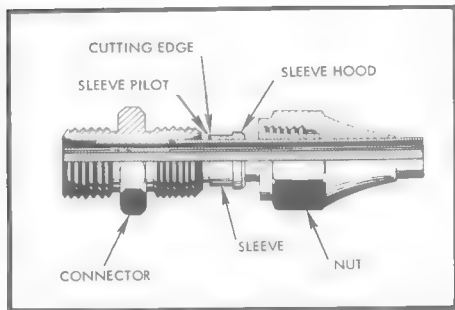


WIGGINS TYPE QUICK-DISCONNECT  
(USED ON STABILIZER ACTUATOR RETURN LINES AT AFT SECTION FIELD BREAK)

FJ-48-2-58-33

Figure No. 3-8. Hydraulic Quick-disconnect Couplings (Sheet 2)





**Note** Flareless tube fittings can be identified from the flared tube fittings by their color. Flareless tube fittings are undyed and the flared tube fittings are dyed. Always use undyed fittings when assembling flareless tube assemblies.

**1** Cut tube to length, with ends square, burr inside and out, keeping edges as sharp as possible in order to make a good bearing on the seat of the body.

**2** Slide the nut, then the sleeve over tubing and preset the sleeve.

**3** Presetting of the sleeve may be accomplished by any of the three following methods:

- A. Use a power operated presetting machine.
- B. Use a hardened steel presetting tool, with one end machined identical to the fitting.
- C. If tooling is not available, a standard fitting may be used. (Do not use the same fitting for presetting more than two or three times.)

**4** If method "B" or "C" is used, proceed as follows:

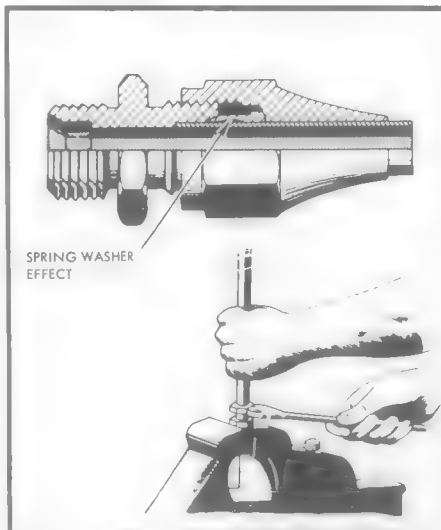
- A. Apply a thin coating of petrolatum (item 100, materials list) to threads and angular internal seat of fitting.

**Caution** Absolutely no compound should be applied or allowed to remain on the end of a fitting where it may enter the system and cause malfunction.

- B. Place fitting in a vise and hold tubing firm and square on seat in fitting.

- C. Tighten nut until cutting edge of sleeve grips tubing. This point is determined by slowly turning the tubing back and forth while tightening the nut. When the tubing no longer turns, the nut is ready for final tightening.

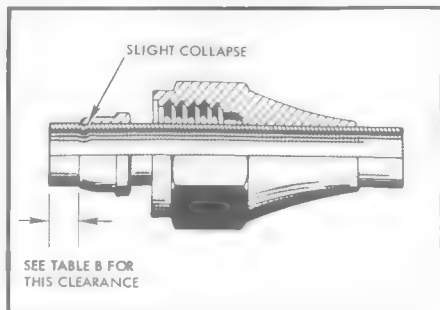
- D. After the sleeve grips the tubing, tighten the nut 1-1/16 turns for all sizes of tubing and all types of tubing material.



FJ-48-2-58-28

Figure No. 3-9. Assembling and Installing Flareless Hydraulic Tube Assemblies (Sheet 1)

- 5** After presetting of the sleeve, the following points should be checked:
- The lip of the sleeve should contact or be very close to the outer diameter of the tube. It may have a clearance as shown in table "A." If clearance exists, it should be checked with a gage.
  - A slight collapse of the inner diameter of the tube at the sleeve cut and at the shoulder is permissible.
  - The sealing surface of the sleeve must be smooth and free from nicks and scratches.
  - Rotation of the sleeve is permitted. A 1/64-inch lengthwise movement of the sleeve is permitted with 6061-T6 aluminum lines and with steel lines. A 1/32-inch lengthwise movement is permitted with 5052-O aluminum lines.
  - The distance from the sleeve to the end of the tube shall be as shown in table "B."



- 6** Place the assembly with the preset sleeve in the installed position. Turn the nut at low torque to seat the tube squarely and firmly in place in the fitting body.
- 7** When contact has been made and the parts are snug, turn the nut not less than one-sixth and not more than one-third turn, using a wrench on the hexagonal of the body to prevent the body from turning.

MAXIMUM CLEARANCE BETWEEN SLEEVE AND TUBE OD		
TUBE SIZE	5052-O AND 6061-T6 ALUMINUM	CRES
3/16	0.005	0.007
1/4	0.005	0.007
5/16	0.007	0.010
3/8	0.007	0.013
1/2	0.010	0.013
5/8	0.013	0.013
3/4	0.013	0.013
1	0.013	0.013
1-1/4	0.015	0.015
1-1/2	0.015	0.015
1-3/4	0.015	0.015
2	0.015	0.015

TABLE A

DISTANCE FROM SLEEVE TO TUBE END		
TUBE SIZE	MINIMUM	MAXIMUM
3/16	0.100	0.155
1/4	0.100	0.155
5/16	0.125	0.160
3/8	0.125	0.170
1/2	0.135	0.185
5/8	0.145	0.200
3/4	0.155	0.215
1	0.190	0.250
1-1/4	0.210	0.280
1-1/2	0.230	0.310
1-3/4	0.250	0.320
2	0.250	0.320

TABLE B

FJ-48-2-58-29

Figure No. 3-9. Assembling and Installing Flareless Hydraulic Tube Assemblies (Sheet 2)

**CAUTION**

- Never stretch hose between fittings. Slack equal to at least 5 percent of hose length must be allowed for operation and shrinkage.
  - Flexible hoses are provided with a lengthwise marking that must be kept straight after installation. Pressure tends to straighten hose and, if hose is twisted, the pressure tends to shear off hose ends or to loosen fittings.
- e. Whenever possible, make sure hose is clear of adjacent parts to prevent chafing during operation.
- f. When clamps are used, make sure hose is not pulled, twisted or forced to bend at a sharp radius.

**INSTALLING FLEXIBLE HOSES HAVING MS FITTINGS.** To install flexible hoses with MS fittings, proceed as follows:

- a. Lubricate male threads of fittings sparingly with petrolatum (item 100, materials list).

**CAUTION**

Absolutely no compound should be applied or allowed to remain on end of fitting where it could enter the system and cause malfunctions.

- b. Start the nut on the fitting and turn at a low torque to seat the hose end firmly in place against fitting.

**Note**

To determine when the hose end is seated, note rapid increase in torque required to turn nut.

- c. When hose end is firmly seated, turn nut not less than one-sixth and not more than one-third of a turn.

**Note**

Use a wrench on the hex of fitting to prevent it from turning while tightening the hose end.

- d. Make sure hose is not twisted and install other end in the same manner.

**CAUTION**

- Never stretch hose between fittings. Slack equal to at least 5 percent of hose length must be allowed for operation and shrinkage.
  - Flexible hoses are provided with a lengthwise marking that must be kept straight after installation. Pressure tends to straighten hose and, if hose is twisted, the pressure tends to shear off hose ends or to loosen fittings.
- e. Whenever possible, make sure hose is clear of adjacent parts to prevent chafing during operation.

- f. When hose clamps are used, make sure hose is not pulled, twisted or forced to bend at a sharp radius.

**HYDRAULIC PACKINGS AND BACKUP RINGS.**

Hydraulic packings and backup rings are installed throughout the airplane's hydraulic system to minimize internal and external leakage of hydraulic fluid, thereby preventing loss of system pressure. Except for a few "V" type packings, all seals in this system are the "O" ring type. Hydraulic packings ("O" rings) are used as internal pressure seals on a sliding or moving assembly as well as static pressure seals between nonpositioning and universal fittings and bosses. Frequently on installations where "O" ring type packings are used, Teflon or leather backup rings are installed as nonextrusion devices to prevent the seals from being damaged. Hydraulic packings are manufactured from synthetic rubber and are identified by a blue dot on the outer circumference of the packing. The blue dot also indicates the seals are suitable for use in a hydraulic system using hydraulic fluid with a mineral base. (See figure 3-10.)

**HANDLING OF HYDRAULIC PACKINGS AND BACKUP RINGS.** The successful operation of a hydraulic system and the units within depend greatly on methods and procedures used in handling and installing hydraulic packings and backup rings. These seals are comparatively soft and should not be subjected to handling which might cause nicks, scratches or dents. They should be kept free of dirt and foreign matter and should not be exposed to extreme weather conditions. When hydraulic packings and backup rings are chosen for installation, they should not be picked up with sharp instruments and the preservative should not be removed from the seals until the seals are ready for installation.

**INSTALLING "O" RING PACKINGS.** The following procedure contains general rules to be followed when replacing hydraulic packings:

- a. Using all necessary precautions, remove the unit from the airplane.
- b. Prepare a clean working area and provide the necessary tools and equipment.
- c. Taking the necessary precautions on the type of unit involved, disassemble the unit far enough to replace the seal.
- d. Determine the correct size by checking the Parts Catalog of the vendor.

**CAUTION**

Only under extreme circumstances should an attempt be made to determine the required replacement size by taking measurements of the old seal.

- e. Replace the old seal with one of the same material.
- f. Re-examine the seal for the correct size, shape, material and for any defects such as nicks, cuts, dents, etc.



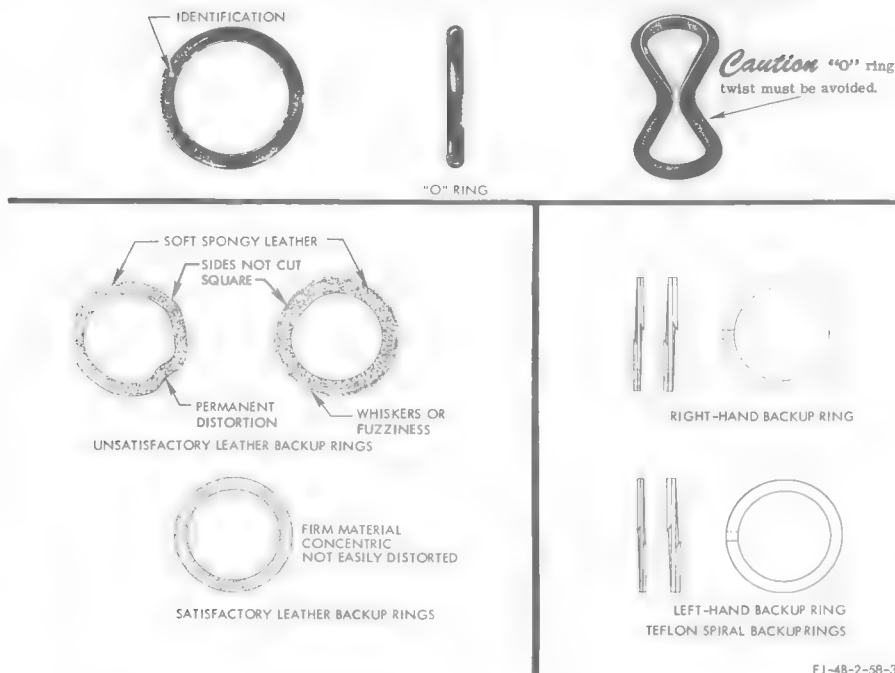


Figure No. 3-10. Hydraulic Packings and Backup Rings

g. Immerse the seal in the same type of hydraulic fluid which is used in the system and install while seal is wet.

h. Avoid stretching the seal more than is necessary when installing.

### CAUTION

Never use sharp tools or instruments when removing or installing a seal.

i. After fitting the seal into place, be sure to work out any existing twist in the packing. This is usually done by gently rolling the seal.

### Note

If assembly on which seal is installed has to be inserted through a rough or threaded section of the unit, extreme care should be used to prevent seal from being damaged.

**INSTALLING LEATHER BACKUP RINGS.** The following procedure should be used when installing leather backup rings.

a. Preparation for installation of leather backup rings is the same as preparation for installation of "O" ring packings. (Refer to paragraph, **INSTALLING "O" RING PACKINGS.**)

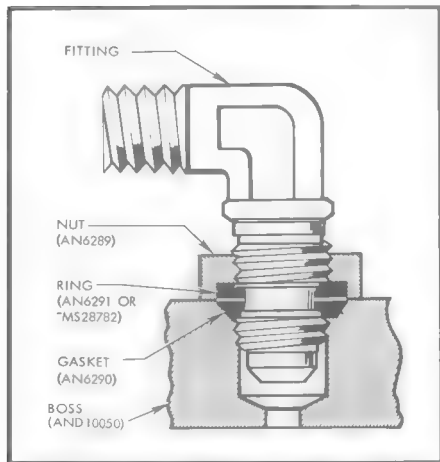
b. When selecting a leather ring for a sliding installation, reject any rings which have a fuzzy whisker appearance.

c. Press and roll the leather ring between the fingers and reject the ring if the edges cannot be felt. This type of ring can permit the deposit of undesirable particles in the hydraulic system. A mushy ring may roll and twist in the groove and cause leakage and early failure of the "O" ring.

### CAUTION

In a sliding installation, always place the smooth grain side of the leather ring against the "O" ring. If this is not done, the life of the "O" ring will be greatly reduced.

FITTING INSTALLATION SUITABLE FOR NORMAL  
OPERATING PRESSURE UP TO AND INCLUDING 3000  
PSI



**Note** When using leather backup rings, install smooth side of leather against gasket.

d. In a sliding installation, if only one leather ring is used in a groove with an "O" ring, always install the leather ring *away* from the high-pressure side of the "O" ring.

e. Allow the leather rings to soak in a pan of clean hydraulic fluid long enough to make the rings pliable for good installation.

f. In cases where it is difficult to install leather rings in one-inch and smaller diameter grooves, the leather rings may be soaked in water until they can be stretched into place. The use of a mandrel in this operation is advisable.

g. After installation of the water soaked leather rings, place the assembly in an oven with circulating air at a temperature of 71°C (160°F) until the leather returns to its original shape and size.

**CAUTION**

Do not install "O" rings until the leather rings have been installed and dried.

UNIVERSAL FITTINGS

**1** Coat male threads of fitting, AN6291 leather or MS28782 teflon backup ring and gasket sparingly with petrolatum (item 100, materials list) or hydraulic fluid (item 95, materials list) and assemble fitting as shown. Work AN6291 leather or MS28782 teflon backup ring into counterbore of nut; then turn nut down until gasket is pushed firmly against lower threaded section of fitting.

**2** Install fitting in boss and at the same time keep nut turning with fitting until gasket contacts boss. This point can be determined by a sudden increase in torque. With fitting in this position, put a wrench on the nut to prevent nut turning and at the same time turn fitting in 1-1/2 turns. Position fitting by turning fitting in not more than one additional turn.

**3** Hold fitting and turn nut down tightly against boss.

NONPOSITIONING-TYPE FITTINGS

**1** Lubricate gasket with hydraulic fluid (item 95, materials list).

**2** Install gasket on fitting in gasket groove.

**3** Screw fitting assembly in boss and tighten until fitting bottoms firmly against boss.

FJ-48-2-58-32

Figure No. 3-11. Installing Hydraulic Fittings

INSTALLING TEFLON SPIRAL BACKUP RINGS.

a. If the spiral rings have been stored for a long period of time without the use of mandrels, a condition of overlap may develop. In order to eliminate this condition, the Teflon rings should be stacked on a mandrel of a diameter comparable to the desired diameter of the spiral ring. The rings should be stacked and clamped with their coils flat and parallel.

b. Place the rings in an oven at 177°C (350°F) maximum for a period of approximately 10 minutes.

c. Remove rings, water quench and store at room temperature for 48 hours.

**CAUTION**

Upon installation, always make sure that the spirals are in the proper direction.

d. When installing the Teflon spiral rings in internal grooves, the rings shall have a right-hand spiral. (See figure 3-10.) Install the rings into the groove; then,

rotate the unit in a clockwise direction while inserting it into the mating unit. This action will tend to expand the ring diameter and reduce damage.

e. When installing the Teflon spiral rings in external grooves and the grooves are open to observation, no special instructions are necessary. If the grooves are hidden, the rings shall have a left-hand spiral. (See figure 3-10.) Install the rings into the grooves; then, rotate the unit in a clockwise direction while inserting into the mating unit. This action will tend to contract the ring diameter and reduce damage.

#### TEST POINT TROUBLE SHOOTING.

To ease and expedite electrical maintenance, test point trouble shooting data has been incorporated in system trouble isolation procedures and system wiring diagrams. As any system failure or malfunction may result from any one or a combination of electrical, hydraulic, pneumatic or mechanical reasons, all probable causes (reasons) for a stated trouble are covered in the same trouble isolation chart. There are three types of test points: major, secondary and minor. Textual references to these test points are made within each system trouble shooting paragraph and the specific location of each test point may be determined by referring to the appropriate system wiring diagram in Section X. No test point designation will be duplicated nor will more than one test point designation be given to any test point.

#### MAJOR TEST POINTS.

Major test points are used to isolate a power system failure to a physical portion of the airplane or to a group of systems. Major test points are symbolized on system wiring diagrams by a star encircled Arabic numeral. Major test points are referred to in text as: test point 1, test point 2, etc. Some examples of major test points are: generator and inverter outputs, power distribution connections, etc.

#### SECONDARY TEST POINTS.

Secondary test points are used to isolate failure to a specific system or to a specific item within a system. Secondary test points are symbolized on system wiring diagrams by an encircled capital letter(s). The letters "I" and "O" are not used to avoid confusion with the numerals one and zero. Secondary test points are referred to in text as: test point A, test point AB, etc. Some examples of secondary test points are: power inputs to individual units, tie-ins with parallel or inter-related systems, sequence switches, etc. Secondary test points for any specific system will always have as their initial identifying letter the same letter as the initial letter of the wire numbers of that system.

#### MINOR TEST POINTS.

Minor test points are used to isolate failure within a unit. Minor test points are symbolized on system wiring diagrams by an encircled capital letter and Arabic numeral. The letters "I" and "O" are not used to avoid confusion with the numerals one and zero. Minor test points are referred to in text as: test point A1, test point

A2, etc. Some examples of minor test points are: continuity through a switch or a relay that is part of a unit, resistance readings of items within a unit, etc. Minor test points for any specific system will always have as their initial identifying letter the same letter as the initial letter of the wire numbers of that system.

#### USE OF TROUBLE SHOOTING CHARTS.

The best trouble shooting aid is preventive maintenance and cleanliness. The next best trouble shooting aid is thorough knowledge of the theory and operation of the system in question. A thorough knowledge of the system permits rapid determination of the most likely probable cause for any given trouble and thereby reduces trouble shooting time and effort. The third most important aid is safety; observe all safety rules, check to make sure that the airplane and any attached ground power equipment is properly grounded, check to make sure that all ground safeties are installed, follow the trouble shooting instructions and if it is a two-man job, get another man to help. What is the trouble? Check the squawks, observe or perform an operational or functional check of the system in question. Check the trouble shooting charts of the system for the determined trouble. Select the most probable cause(s) and proceed to isolate the trouble; set up the system as specified in the "System Conditions" portion of the chart. Use the appropriate meters. Do not make ohmmeter tests or continuity checks on an electrically "hot" airplane. Complete check-out of the system in question without correction of the trouble may indicate that a parallel or interrelated system is at fault. If so, refer to that system for appropriate trouble shooting information. When a remedy is performed that does not correct the trouble, select the next most probable cause and continue trouble shooting. Isolation procedures are set up to require a minimum of effort. Each procedure should either isolate the trouble itself or isolate the portion of the circuit that contains the trouble. When a test point procedure is called out for an item (for example, a valve solenoid), parts of that procedure not spelled out which may lead to isolating the fault are: visual inspection for signs of physical damage, check of the ground connection or bonding and a check for good electrical connections. Similarly, when test points are called out for relay terminals, the switch section of the relay involved should be checked for proper action and continuity. The various portions of the trouble shooting charts and their functions are as follows:

a. **TEST EQUIPMENT.** This portion of the charts contains a list of all test equipment that will be required to perform any isolation procedure that follows on the same chart.

b. **SYSTEM CONDITIONS.** This portion of the charts specifies the desired system conditions for the tests that will follow. Some isolation procedures may require a change to these conditions; if so, the new conditions will be given in note form.

c. **TROUBLE.** This is the observed symptom, malfunction, or fault.

d. **PROBABLE CAUSE.** The probable cause(s) states the condition or reason causing the trouble. Probable causes are listed in their most likely order. The probable causes may be electrical, mechanical, hydraulic, pneumatic, etc, or a combination of these reasons.

e. **ISOLATION PROCEDURE.** This portion of the charts is a positive statement of action. If the probable cause is nonelectrical, there will be no mention of test points; if electrical, specific directions related to one or more test points will be given. Isolation procedures are listed in their most likely or accessible order. What meter is to be used will be determined by the required meter reading(s). Use the appropriate system wiring diagram in Section X to locate test points and to perform wire segment continuity checks. Many isolation procedures require the use of test points located at a connector. In such cases, it is necessary to disengage the connector and to apply the test probe to the plug or receptacle portion of the connector as shown on the system wiring diagram. Connectors should never be disengaged with electrical power applied to the airplane. Do not damage connector sockets by inserting test probes.

f. **METER READING.** If the isolation procedure is nonelectrical, this portion of the chart will indicate that none is required. If test points have been specified in the isolation procedure, the value and type of reading will be stated. Resistance and voltage readings are the type most commonly required for the isolation procedures; values given will indicate their type and the corresponding type of meter should be used to obtain the reading.

g. **REMEDY.** For nonelectrical isolation procedures, the remedy will indicate the maintenance action required depending upon the results of the isolation procedure. For electrical isolation procedures, the remedy will indicate the maintenance action required for the meter reading obtained. Most remedies will indicate a definite maintenance action, but some remedies will indicate that further isolation procedures should be performed. Some meter readings will indicate that the airplane wiring is at fault (open or shorted) and the remedy will be to perform a wire segment continuity

check. Such continuity checks should be performed so as to minimize effort. Remove power and disconnect wires as necessary; then, check for continuity at the most accessible mid point of the circuit; in this manner, several wire segments can be checked for continuity at one time.

## WARNING

Never disconnect wires or disengage disconnects with electrical power applied to the airplane. Always ground the airplane and any attached ground power equipment.

### Note

Secondary test points are listed alphabetically and opposite to each applicable wiring diagram title. Figure numbers of the wiring diagrams listed can be found in the Wiring Diagram Index of Section X of this handbook. Major test points, not listed, can be found in the Starting and D-C Generating System, the D-C Power Distribution System and the A-C Power Supply and Distribution System wiring diagrams. Minor test points, also not listed, can be found by associating them with similar secondary test points.

TEST POINT	WIRING DIAGRAM TITLE
CSA-CSZ	Speed Brakes and Position Indicator
G, GA-GZ and GAA-GAZ	Landing Gear Sequencing System
GBA-GBZ	Landing Gear Warning and Indicating System
GCA-GCZ	Landing Gear Sequencing System (Landing gear emergency extension)
GDA-GDZ	Wing Fold System
GEA-GEZ	Arresting Hook System

## CONSUMABLE MATERIALS

ITEM NO.	NOMENCLATURE	SPECIFICATION OR STOCK NO.	MANUFACTURER	SUBSTITUTE
9	Anti-seize Compound, White-lead Base, General Purpose (For Threaded Fittings)	JAN-A-669; Stock No. R52C3095		
10	Deleted.			
64	Grease, Graphite, Aircraft Lubricating	MIL-G-7187; Stock No. WM9150-190-0922		
76	Lacquer Thinner	TT-T-266; Stock No. R52T593; Stock No. G8010-160-5789		MIL-T-6094

ITEM NO.	NOMENCLATURE	SPECIFICATION OR STOCK NO.	MANUFACTURER	SUBSTITUTE
82	Lubricating Grease (General Purpose Aircraft)	MIL-L-7711; Stock No. WF9150-257-5361		
<div style="border: 1px solid black; padding: 5px; text-align: center; margin: 10px auto; width: 150px;">CAUTION</div> <ul style="list-style-type: none"> <li>● The special synthetic oils used in this grease may soften paint, natural rubber, neoprene and electrical insulating materials.</li> <li>● This grease should not be used on equipment requiring extreme pressure or special anti-wear additives.</li> </ul>				
83	Lubricating Grease, High-temperature	MIL-L-3545; Stock No. WF9150-223-4003		
<p style="text-align: center;"><b>Note</b></p> <p>This material is satisfactory in many instances for antifriction bearings which are required to start at a temperature of -40°C (-40°F) if an adequate run-in period is allowed to channel the grease properly before attempting low-temperature starting.</p>				
87	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base	MIL-L-7808; Stock No. WS9150-227-0184		
95	Oil, Hydraulic, Aircraft, Petroleum Base	MIL-O-5606; Stock No. WR9150-223-4134		
96	Oil, Preservative, Hydraulic Equipment	MIL-O-6083; Stock No. WF9150-265-4412		
<p style="text-align: center;"><b>Note</b></p> <p>The rust-preventive additive increases the low-temperature viscosity of this oil and, consequently, it is not suitable as an operating fluid in aircraft hydraulic systems.</p>				
100	Petrolatum, Technical	VV-P-236; Stock No. WS9150-250-0926		
102	Primer, Zinc Chromate, For Aircraft Use	MIL-P-6889, Type I; Stock No. R52P20660-25		
<p style="text-align: center;"><b>Note</b></p> <p>To obtain the pretinted primer, include the following information: "Pretinted to match interior green, color No. 611." Untinted zinc chromate primer will be applied over wash primer (Specification MIL-C-8514) on surfaces to be painted with lacquer topcoats.</p>				
119	Solvent, Dry Cleaning (Stoddard Solvent)	P-S-661, Type I; Stock No. W6850-264-9039		
131	Thread Compound, Anti-seize, Graphite-petrolatum	MIL-T-5544; Stock No. R52C3053		
132	Toluene	JAN-T-171; Stock No. W5610-281-2005		



**UTILITY HYDRAULIC POWER SYSTEM****3-1. UTILITY HYDRAULIC POWER SYSTEM.**

3-2. The utility hydraulic power system is a closed center, constant pressure-type system. It supplies hydraulic fluid under pressure to the following hydraulically operated subsystems: wing fold, landing gear (including the nose gear's "one shot" emergency extension system), wheel brakes, speed brakes, arresting gear, wing flap spoilers and gun bay purge doors. The engine-driven pump is the hydraulic power source and supplies the utility hydraulic system with a maximum pressure of 3000 psi. Integral controls in the engine-driven pump housing automatically regulate pump output according to the demands of the subsystem in operation. A pressurized-type fluid reservoir is installed in the utility hydraulic power system to retain hydraulic fluid and to provide the engine-driven pump with a positive flow of hydraulic fluid. Reservoir capacity is 2.7 U. S. gallons. The reservoir pressurization system supplies the fluid reservoir with a differential pressure of 10 to 15 psig to prevent engine-driven pump cavitation when the engine is operating. A pressure relief valve set to crack at 3450 ( $\pm 50$ ) psi is installed between the utility hydraulic system pressure and return lines to protect the utility hydraulic system from excessive pressure caused by fluid surges, thermal expansion and engine-driven pump automatic control failure. The wheel brake system priority valve is installed in the utility hydraulic power system pressure line to ensure the wheel brake system of 1000 psi during all utility hydraulic system operations. Fluid filters are installed in the utility and brake system return lines to filter the hydraulic fluid just prior to its return to the reservoir. Both filters are line-type, micron type filters. A remote reading pressure indicating system, integrated with the flight control hydraulic systems, provides visual indication of utility hydraulic system pressure when selected. A ground test connection panel is incorporated in the utility hydraulic power system to provide attaching points for ground test equipment. (See figure 3-12.)

**3-3. FUNCTION OF UTILITY HYDRAULIC POWER SYSTEM.**

3-4. When the engine is operating, the fluid reservoir is pressurized and a positive supply of hydraulic fluid flows to the engine-driven pump. The engine-driven pump pressurizes the hydraulic fluid and maintains the output necessary to meet the demand of the subsystem in operation. The pressurized hydraulic fluid is routed to the pressure relief valve where pressure in excess of 3450 ( $\pm 50$ ) psi is relieved and fluid is returned to the reservoir in the event of a pressure surge or engine-driven pump automatic pressure regulator failure. The priority valve in the pressure line receives the pressurized hydraulic fluid and retains 1000 psi to ensure wheel brake

operation in the event of low pump output or by-passing of fluid downstream of the priority valve. When pressure becomes sufficient to unseat the priority valve, fluid is directed through the control valve to the actuating unit of the selected subsystem. When the hydraulic unit is actuated, static fluid on the return side of the unit piston is forced back through the control valve to the reservoir through the return line. The return fluid is filtered prior to entering the reservoir. Pressurized hydraulic fluid is tapped off for the pressure indicating system upstream of the priority valve. (See figure 3-13.)

**3-5. OPERATIONAL CHECK OF UTILITY HYDRAULIC POWER SYSTEM.**

3-6. Before an operational check of the utility hydraulic power system is started, the system must be properly serviced. (Refer to paragraph 3-8.)

**Note**

Perform operational check in sequence outlined and correct any noted discrepancies before proceeding. If operational check does not meet normal requirements, refer to paragraph 3-7.

- a. Place airplane on jacks. (Refer to paragraph 1-14.)
- b. Obtain test stand capable of producing 13 gpm at 3000 psi with a 10-micron or finer degree of filtration.
- c. Connect the pressure and suction lines from the test stand to their respective fittings on the ground test connection panel.
- d. Charge nose gear emergency extension accumulator. (Refer to paragraph 3-8.)
- e. Connect an external electrical power source to airplane.
- f. Operate each subsystem in the utility hydraulic system through all phases of its operation at least ten times.

**Note**

Refer to the operational check of each subsystem before operating to obtain correct setting on hydraulic test stand.

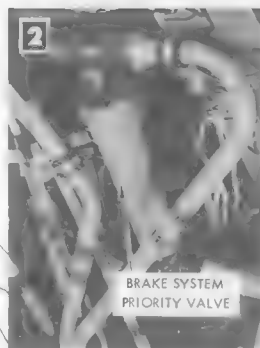
**CAUTION**

Test stand temperature must not be allowed to exceed 60°C (140°F) during operation.

- g. Exhaust pressure and disconnect test stand from airplane.
- h. Disconnect external electrical power source from airplane.
- i. Remove jacks from airplane.
- j. Start airplane engine. (Refer to paragraph 1-9.)

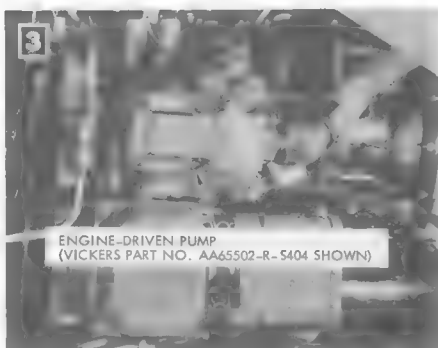
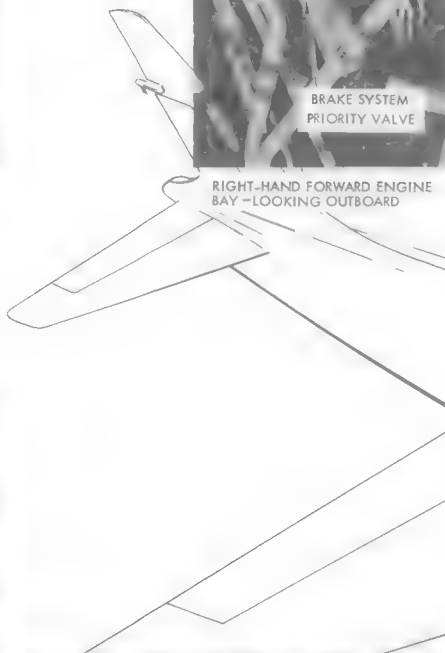


LOWER ENGINE ACCESS - RIGHT-HAND SIDE



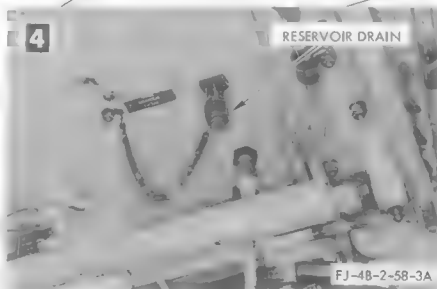
BRAKE SYSTEM  
PRIORITY VALVE

RIGHT-HAND FORWARD ENGINE  
BAY - LOOKING OUTBOARD



ENGINE-DRIVEN PUMP  
(VICKERS PART NO. AA65502-R-5404 SHOWN)

ENGINE REMOVED FROM AIRPLANE FOR CLARITY



RESERVOIR DRAIN

FJ-4B-2-58-3A

RIGHT-HAND WHEEL WELL - LOOKING UP AND INBOARD

Figure No. 3-12. Utility Hydraulic Power System Unit Location (Sheet 1)



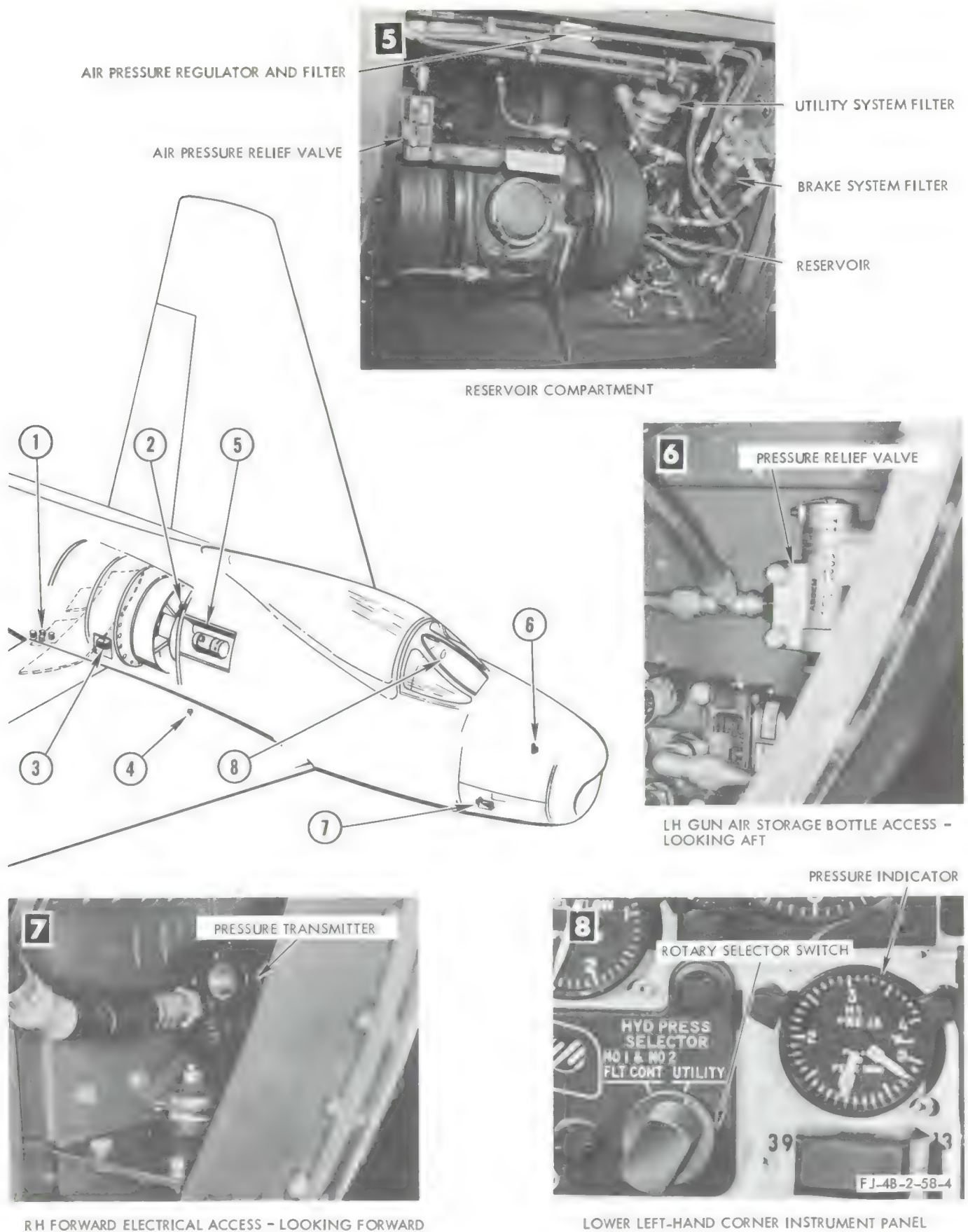
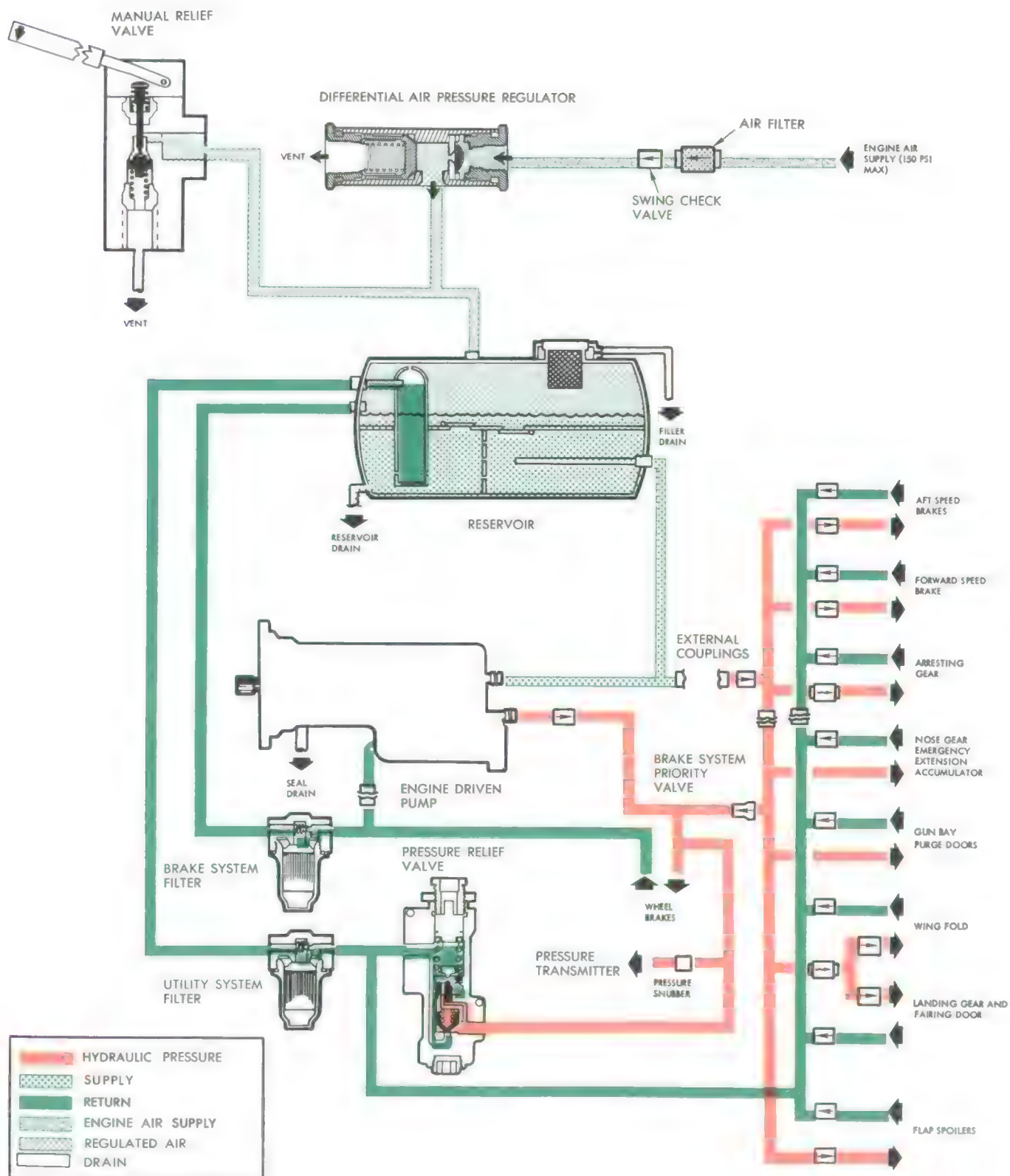


Figure No. 3-12. Utility Hydraulic Power System Unit Location (Sheet 2)



FJ-48-2-58-5

Figure No. 3-13. Utility Hydraulic Power System Schematic

k. With none of the subsystems operating, position HYD PRESS SELECTOR switch on pilot's instrument panel to "UTILITY." Both pointers on dual reading indicator should align and indicate 3000 psi.

l. Operate speed brakes. At the termination of each half cycle of operation, pressure build-up should be immediate.

m. Shut down engine. (Refer to paragraph 1-9.)

n. Visually check all utility hydraulic system units for leakage.

### 3-7. TROUBLE SHOOTING UTILITY HYDRAULIC POWER SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>SYSTEM WILL NOT BUILD UP PRESSURE.</b>		
Insufficient fluid in reservoir.	Check reservoir fluid level sight gage.	Fill reservoir. (Refer to paragraph 3-8.)
Engine-driven pump suction or pressure hose not connected at quick-disconnect coupling.	Visually check hoses through right-hand engine access door.	Connect lines.  <b>Note</b>  If pump suction hose was not connected and engine was operated, pump may have to be replaced.
Faulty engine-driven pump.	Check fluid level in reservoir. If reservoir is full, attach hydraulic test stand to ground test connection panel and check for internal leakage. If pressure builds up and holds, pump is faulty.	Replace engine-driven pump.
Control unit in engine-driven pump faulty.	Check fluid level in reservoir. If reservoir is full, attach test stand and check for internal leakage. If pressure holds, pump is faulty.	Replace engine-driven pump.
Pressure relief valve faulty or improperly adjusted.	Gain access to relief valve. (Refer to paragraph 3-37.) Pressurize hydraulic system and listen for a squealing noise or feel valve for vibration or overheating. If conditions are heard or felt, valve is improperly adjusted or defective.	Adjust or replace relief valve. (Refer to paragraph 3-39.)
Pressure transmitter or indicator faulty.	Connect a hydraulic test stand equipped with a master gage to the ground test connection panel. Position HYD PRESS SELECTOR switch to "UTILITY." If utility indicator does not agree with master gage, transmitter or indicator is faulty.	Replace defective unit.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>SYSTEM WILL NOT BUILD UP PRESSURE. (Cont)</b>		
Manual dump valve or thermal relief valve in nose gear emergency extension system by-passing fluid to return.	Connect test stand to ground test connection panel. Connect external electrical power source. Pull GROUND SAFETY* (or GROUND SAFETY & OVERVOLTAGE†) circuit breaker in left-hand radio bay. If pressure bleeds off in nose gear emergency extension system after power has been disconnected, manual dump valve or thermal relief valve is by-passing fluid to return.	Replace thermal relief or manual dump valve.
Nose gear emergency extension selector valve by-passing fluid to return.	With emergency extension selector valve in normal position, disconnect its return line. Apply pressure and check for leakage from return port of selector valve. Also, check for quick bleed off of emergency pressure in accumulator.	Replace defective nose gear emergency extension selector valve.
Landing gear emergency extension dump valve or speed brake dump valve improperly rigged or defective.	Disconnect return line from respective valve and apply pressure. If fluid flows from return port, valve is defective or improperly rigged.	Replace defective valve. Properly rig valve. (Refer to paragraphs 3-199 and 3-267.)
<b>SYSTEM PRESSURE BUILDS UP TO 3450 PSI.</b>		
Control unit in engine-driven pump faulty.	Connect hydraulic test stand equipped with master gage to ground test connection panel. Apply pressure and check utility pressure gage reading with master gage reading. If gages synchronize, the control unit in engine-driven pump is faulty.	Replace engine-driven pump.
<b>ENGINE-DRIVEN PUMP CAVITATION.</b>		
Reservoir air pressure regulator or manual relief valve defective.	Check utility hydraulic power system reservoir air pressurization system.	Replace defective unit.
Engine-driven pump case not properly filled before installation.	Check for erratic reading on pressure gage or feel pump for possible overheating.	Remove and fill pump. (Refer to paragraph 3-18.)  <b>Note</b>  If pump was operated without being filled, pump may have to be replaced.
Pump suction hose not connected at quick-disconnect coupling.	Visually check through right-hand engine access door.	Connect hose.  <b>Note</b>  If pump was operated with suction hose disconnected, pump may have to be replaced.

\*Airlanes 139531i through 139555i

†Airlanes 141444j and subsequent

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>EXCESSIVE FOREIGN MATTER IN HYDRAULIC SYSTEM.</b>		
Unit in utility hydraulic system progressively failing.	Remove and inspect filter bowls and elements for rubber chips, metal filings and other foreign material.	Replace defective unit. Drain and flush utility hydraulic system. (Refer to paragraph 3-13.)
System filled with contaminated fluid.	Inspect fluid in hydraulic reservoir.	Drain and flush utility hydraulic system. (Refer to paragraph 3-13.)
<b>LOSS OF HYDRAULIC FLUID IN SYSTEM.</b>		
Hydraulic line or unit in subsystem leaking fluid externally.	Visually check all lines and hydraulic units in utility hydraulic system.	Repair leak.

3-8. FILLING UTILITY HYDRAULIC POWER SYSTEM RESERVOIR. With the landing gear down and the doors closed, the gun bay purge doors and the speed brakes closed, the wings folded, the arresting gear hook up, the wing flap spoilers retracted and the nose gear emergency extension accumulator discharged, complete the following preliminary steps and fill the reservoir with hydraulic fluid (item 95, materials list) as instructed in either method No. 1, No. 2 or No. 3.

**Note**

Reservoir capacity is 2.7 U. S. gallons. Capacity of complete utility hydraulic system is 6.6 U. S. gallons.

- Gain access to the filler cap through the reservoir filler and sight gage door located aft of the canopy on the right-hand side of the fuselage.
- Depressurize the reservoir by raising the air manual relief valve handle.
- Make certain the nose gear emergency extension accumulator is discharged.
- Remove filler cap.

**CAUTION**

Fluid added to the reservoir above the full mark will overflow into the scupper drain around the filler neck. This fluid is piped overboard. Always make sure the filler cap is removed if either method No. 2 or method No. 3 is used. Overfilling the reservoir with the filler cap installed will result in damage on subsequent system operation.

3-9. FILLING UTILITY HYDRAULIC POWER SYSTEM RESERVOIR—METHOD NO. 1.

- Fill reservoir from a sealed fluid container to the full mark on the sight gage.
- Replace filler cap and ensure that the air manual relief valve returns to its former position.

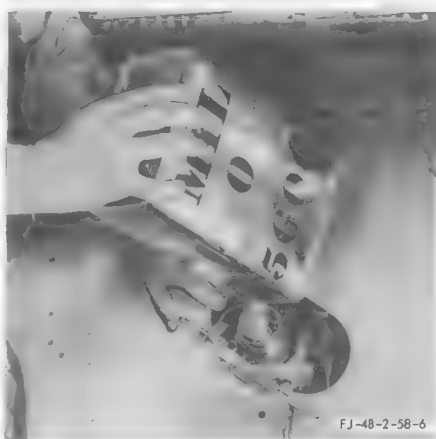


Figure No. 3-14. Filling Utility Hydraulic Power System Fluid Reservoir—Method No. 1

3-10. FILLING UTILITY HYDRAULIC POWER SYSTEM RESERVOIR—METHOD NO. 2.

- Connect an external electrical power source to airplane.
- Connect a test stand pressure line to respective fitting on ground test connection panel.
- Pipe test stand suction line to an external fluid supply such as the test stand reservoir.
- Set test stand to operate at a maximum of 1200 psi with a pump output of not more than 1.5 gpm.
- Operate speed brakes until reservoir is filled to the full mark on sight gage when the speed brakes reach the closed position.
- Disconnect external electrical power source.
- Replace filler cap and ensure that the air manual relief valve returns to its former position.



Figure No. 3-15. Filling Utility Hydraulic Power System Fluid Reservoir—Method No. 2

### 3-11. FILLING UTILITY HYDRAULIC POWER SYSTEM RESERVOIR—METHOD NO. 3.

- a. Connect an external electrical power source to air-plane.
- b. Connect a test stand pressure line to respective fitting on ground test connection panel.
- c. Pipe test stand suction line to an external fluid supply such as the test stand reservoir.
- d. Set test stand to operate at a maximum of 1200 psi with a pump output of not more than 1.5 gpm.
- e. Manually hold nose landing gear emergency extension dump valve to the open position until fluid level in reservoir has reached the full mark on the sight gage.
- f. Release dump valve.
- g. Disconnect external electrical power source.
- h. Disconnect hydraulic test stand.
- i. Operate the nose gear emergency extension dump valve.
- j. Replace filler cap and ensure that the air manual relief valve returns to its former position.

3-12. PURGING UTILITY HYDRAULIC POWER SYSTEM. To purge the utility hydraulic power system or any subsystem in the utility hydraulic system of air, refer to paragraph 3-6 and perform steps a. through j.

3-13. DRAINING AND FLUSHING UTILITY HYDRAULIC POWER SYSTEM. To drain the utility hydraulic power system or any subsystem in the utility hydraulic system, proceed as follows:

- a. Depressurize utility hydraulic system reservoir by operating the air manual relief valve.
- b. Discharge nose landing gear emergency extension system by operating the manual dump valve.
- c. Remove reservoir filler cap.



Figure No. 3-16. Filling Utility Hydraulic Power System Fluid Reservoir—Method No. 3

- d. Place container capable of holding contents of the reservoir under reservoir drain valve in right-hand main gear wheel well and remove drain cap.

- e. In order to drain fluid remaining in the utility hydraulic system, disconnect lines at several low points throughout the system.

To flush the utility hydraulic power system or any subsystem in the utility hydraulic system, proceed as follows:

- a. Disconnect pressure and return lines of the affected system at the actuating unit or units and connect them to one another.

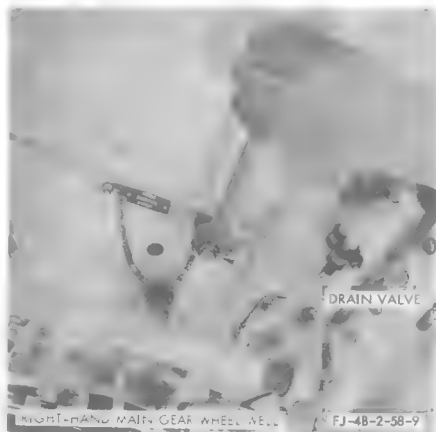


Figure No. 3-17. Draining Utility Hydraulic Power System Fluid Reservoir

b. Connect a hydraulic test stand to the ground test connection panel and set to operate for a low flow output.

c. Circulate hydraulic fluid through the affected subsystem for several minutes while operating the subsystem through all phases of its operation. (Refer to operational check of respective subsystems.)

d. Disconnect test stand.

e. Replace or clean filter elements in utility hydraulic power system. (Refer to paragraph 3-52.)

f. Connect pressure and return lines to the respective actuating unit or units.

#### Note

When the hydraulic power system or any subsystem is restored to its correct operating condition after a draining or flushing procedure, it must be properly serviced and thoroughly purged of air. (Refer to paragraphs 3-8 and 3-12.)

### 3-14. UTILITY HYDRAULIC POWER SYSTEM ENGINE-DRIVEN PUMP—VICKERS PART NO. AA65502-R-S404.

#### Note

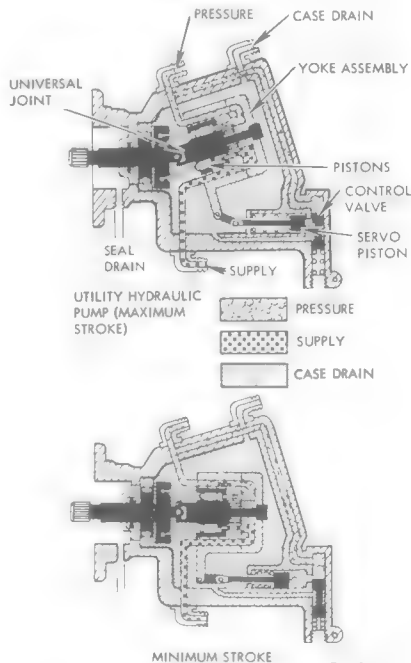
Vickers hydraulic pumps (Part No. AA65502-R-S404 and E13560), with proper hose assemblies and fittings, are completely interchangeable with hydraulic pump—New York Air Brake Part No. 65WB06006 with its respective hose assemblies and fittings. For interchangeability, see figure 3-20.

3-15. The variable volume, engine-driven pump is located on the lower right-hand side of the engine at the upper forward pad of the engine accessory drive section. Access to the engine-driven pump is gained through the engine access door on the right-hand side of the fuselage above the wing and the access panel in the top of the right-hand main gear wheel well. The engine-driven pump is the power source for the utility hydraulic system. It supplies and maintains hydraulic fluid under pressure to the utility hydraulic system up to a pressure of 3000 psi. The pump is a nine-piston, rotary-type with a flow rate of 13 gpm at maximum engine rpm (100% engine speed and 2950 psi) and 5.5 gpm at idle rpm (41% engine speed and 2950 psi). Pumping action is produced by the nine pistons which rotate continuously in a cylinder block that is driven by the pump drive shaft through a universal joint. The cylinder block is supported by a yoke assembly that is stationary and contains bearings and inlet and outlet passageways. Pumping action occurs only when the yoke assembly is at an angle to the drive shaft. This angle is controlled by the pump outlet pressure acting on the integral control unit. The control unit consists of an adjustable control valve, a servo piston and a servo return spring. The servo piston is connected to the yoke assembly by mechanical linkage. When system pressure is below 2950 psi, the servo return spring

forces the yoke assembly to its maximum angle or maximum stroke position. As pump outlet pressure approaches 3000 psi, the control valve admits pressure to the servo piston which, in turn, forces the yoke assembly into alignment with the drive shaft and creates minimum pumping action (zero gpm or flow equal to system leakage). The yoke assembly will assume any angle between minimum and maximum stroke position, depending upon the amount of pressurized fluid demanded by the hydraulic subsystem in operation. Hydraulic fluid that leaks by the rotating assembly and control unit into the pump case serves to lubricate and cool the moving parts of the engine-driven pump. This fluid is circulated back to the reservoir through the case drain line. (See figure 3-18.)

#### CAUTION

Do not disconnect pump case drain line quick-disconnect while pump is operating. This will cause excessive pressure in the pump case and result in blown seals.



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Figure No. 3-18. Utility Hydraulic Power System Engine-driven Pump Schematic (Vickers Part No. AA65502-R-S404)



3-16. UTILITY HYDRAULIC POWER SYSTEM  
ENGINE-DRIVEN PUMP — NEW YORK AIR  
BRAKE PART NO. 65WB06006.

**Note**

This pump, with proper hose assemblies and fittings, is completely interchangeable with hydraulic pumps (Vickers Part No. AA65502-R-S404 and E13560) with their respective hose assemblies and fittings. For interchangeability, see figure 3-20.

3-17. The variable delivery, engine-driven hydraulic pump is located on the lower right-hand side of the engine at the upper forward pad of the engine accessory drive section. Access to the engine-driven pump is gained through the engine access door on the right-hand side of the fuselage above the wing and the access panel in the top of the right-hand main gear wheel well. The engine-driven pump is the power source for the utility hydraulic system and it supplies and maintains hydraulic fluid under pressure to the utility hydraulic system up to a pressure of 3000 psi. The pump is a nine-piston, rotary-type with a flow rate of 13 gpm at maximum engine rpm (100% engine speed and 2600 psi) and 5.5 gpm at idle rpm (41% engine speed and 2600 psi). Pumping action is produced by the rotating motion of the shaft and cam assembly imparting a reciprocating action to the piston assembly. The hollow pistons contain radial relief and by-pass holes and are supported in a stationary cylinder block. The cylinder block contains inlet, outlet and by-pass passages. An integral control or compensator unit, consisting of an adjustable compensator spring, a compensator stem, a spider and piston sleeves, reduces pump flow to zero when a predetermined operating pressure is reached. When the shaft and cam assembly is rotated by the drive coupling, the reciprocating motion starts retracting the piston and the pump check valve in the cylinder block is forced closed, thus creating a vacuum in the cylinder bore. When the piston approaches the fully retracted position, the vacuum created in the cylinder bore draws hydraulic fluid into the cylinder through the radial holes in the piston. As the drive coupling continues to rotate the shaft and cam, the piston is forced forward through the piston sleeve into the cylinder bore to close off the radial holes, thus pressurizing the hydraulic fluid. The pressurized hydraulic fluid is discharged into the pump pressure chamber through the pump check valve, creating maximum flow condition or pumping action. As pressure builds up in the pump pressure chamber, this pressure correspondingly reacts in the compensator port and chamber. When pressure in the compensator chamber approaches the predetermined operating pressure, it becomes sufficient to overcome the calibrated compensator spring and causes the compensator stem, spider and piston sleeve to move toward the front of the pump. As the compensator unit moves forward, the effective stroke of the piston is shortened because the piston moves a greater distance before its radial relief holes are covered by the piston sleeve. When the pump outlet pressure reaches the full predetermined operating pressure, the

compensator unit moves sufficiently forward so that the radial relief holes in the piston do not reach the piston sleeve (thereby reducing the effective stroke to zero to create a minimum flow condition). The compensator unit will assume any position between minimum and maximum flow condition, depending upon the amount of pressurized fluid demanded by the subsystem in operation. When the pump has developed its full predetermined pressure and its output is reduced to zero, pump cooling and lubrication are accomplished through the by-pass holes in the piston and the by-pass passage in the cylinder block. The by-pass holes in each piston are aligned hydraulically with the by-pass passage in the cylinder block when each piston reaches the end of its forward travel. The small quantity of by-pass fluid is circulated back to the reservoir through the case drain line. (See figure 3-19.)

**CAUTION**

Do not disconnect pump case drain line quick-disconnect while pump is operating. This will cause excessive pressure in the pump case and will result in blown seals.

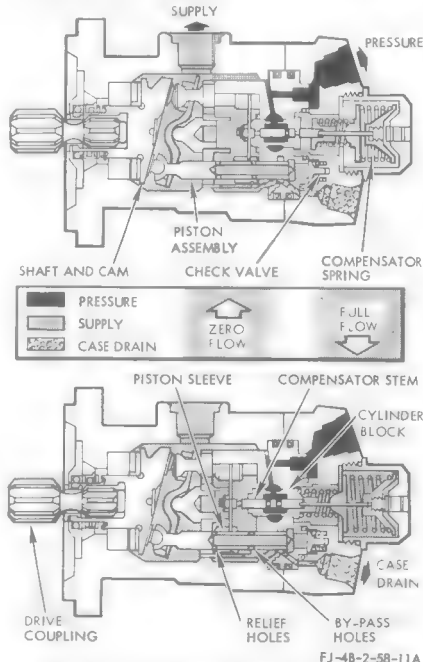
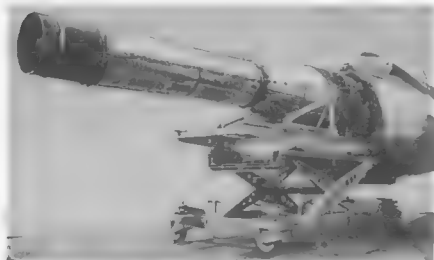


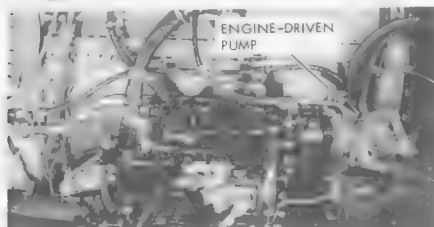
Figure No. 3-19. Utility Hydraulic Power  
System Engine-driven Pump Schematic  
(New York Air Brake Part No. 65WB06006)



## 3-18. REMOVING AND INSTALLING UTILITY HYDRAULIC POWER SYSTEM ENGINE-DRIVEN PUMPS.

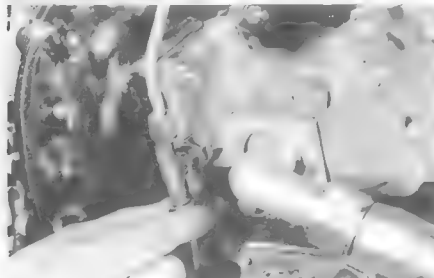


**Note** Removal and installation procedure of the engine-driven pumps is basically the same for all airplanes. For interchangeability of the engine-driven pumps, see figure 3-20.



## REMOVING

- 1** Remove engine from airplane. (Refer to paragraph 5-7.)
- 2** Disconnect pump seal drain lines and cap openings.
- 3** Remove four tie-down nuts and washers securing pump to mounting pads.



**Note** Use 1/2-inch crowfoot and long extension to aid in removing tie-down nuts.

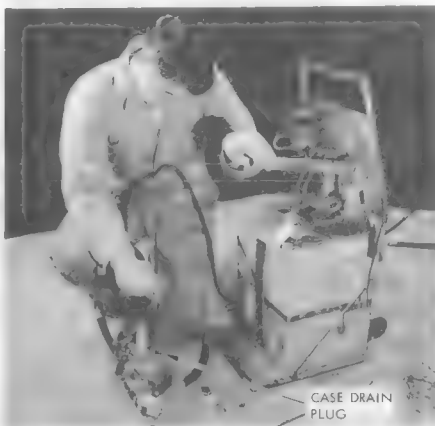
- 4** Support pump and gently work pump forward until splined drive shaft disengages engine accessory drive.
- 5** Remove pump from engine.

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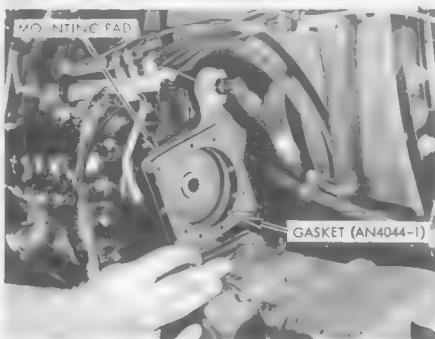
## INSTALLING

**Caution** Before installing the engine-driven pump, the pump housing must be filled with hydraulic fluid (item 95, materials list). This is required to provide the pump with proper lubrication during initial run-up.

- 1** Remove case drain line fitting or plug opposite case drain line fitting and fill pump housing with clean hydraulic fluid.



- 2** Install new gasket on mounting pad.



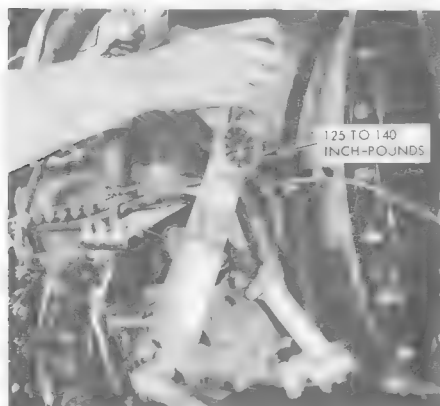
- 3** Position pump drive shaft to engage engine accessory drive and align mounting holes in pump housing with mounting pad studs.
- 4** Gently force pump aft until bottomed against mounting pad.

**Caution** Care must be exercised to prevent damage to the splined drive shaft.

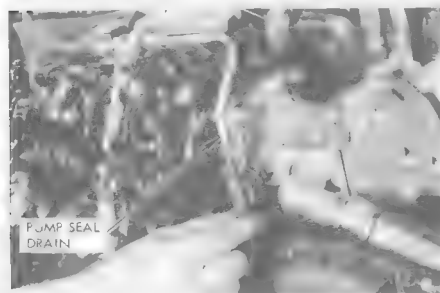
FJ-48-2-58-14



**5** Secure pump with tie-down nut and washers and torque evenly between 125 and 140 inch-pounds.



**6** Remove caps and connect pump seal drain line.



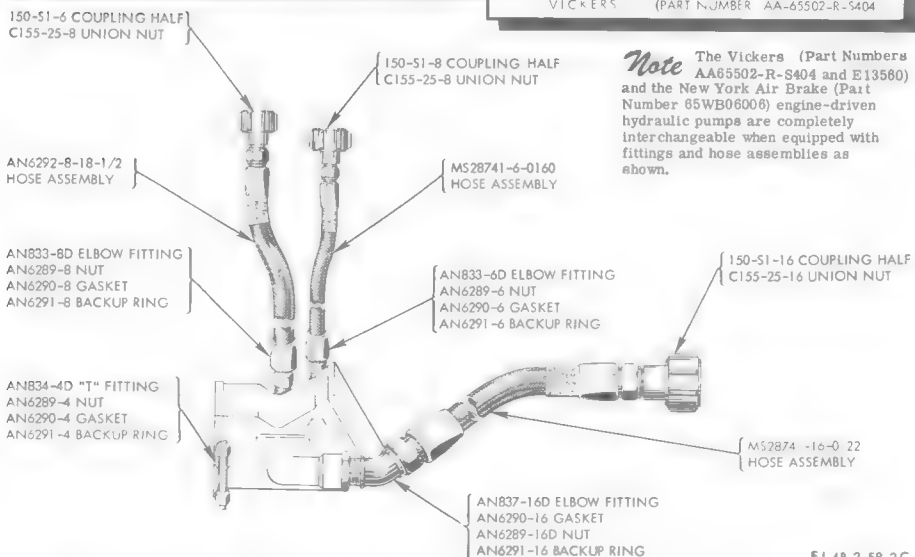
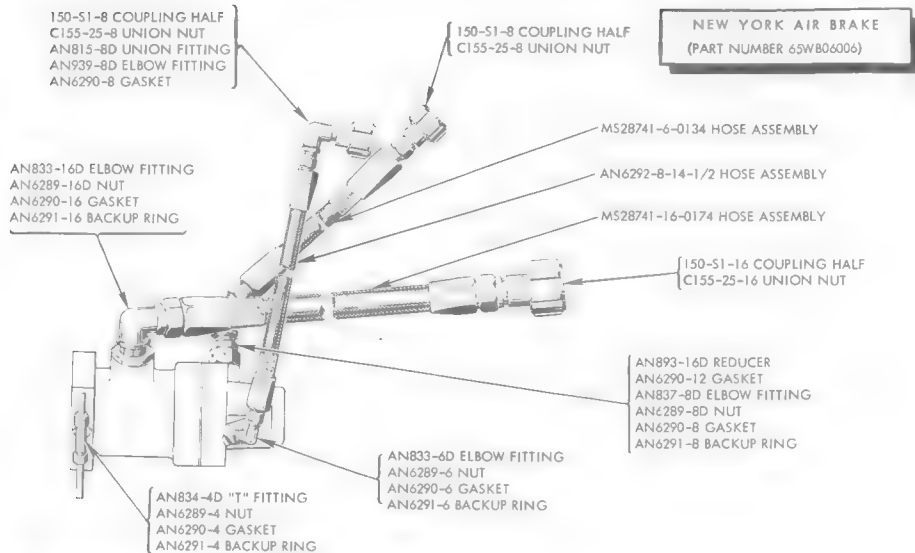
**7** Install engine. (Refer to paragraph 5-7.)

**8** Check utility hydraulic power system. (Refer to paragraph 3-5.) FJ-48-2-58-15

3-19. INTERCHANGEABILITY OF UTILITY HYDRAULIC POWER SYSTEM ENGINE-DRIVEN PUMPS. See figure 3-20.

### 3-20. UTILITY HYDRAULIC POWER SYSTEM FLUID RESERVOIR.

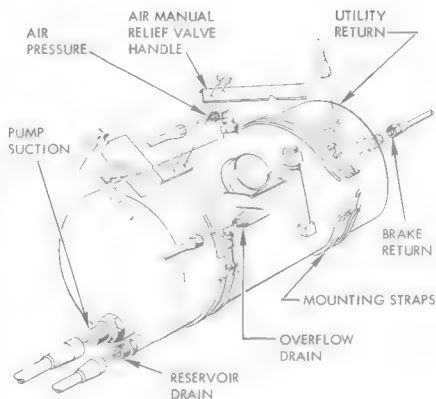
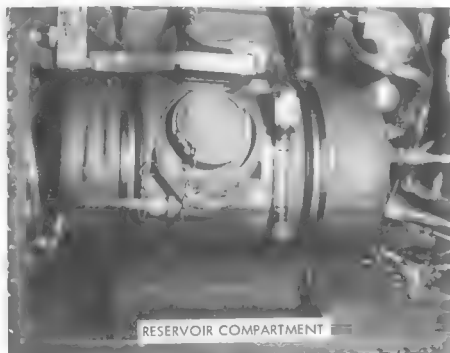
3-21. The utility hydraulic power system fluid reservoir is located on the right-hand side of the fuselage just aft of the canopy. Access to the reservoir is gained by removing the hydraulic reservoir compartment access panel. A small door provides access for servicing. The fluid reservoir is a pressurized type with a capacity of 2.7 U. S. gallons. It stores fluid for the utility hydraulic system and furnishes the engine-driven pump with a positive supply of hydraulic fluid. The reservoir consists of a horizontal and vertical baffle, two spring-loaded flapper valves, an air separator, a filler cap, a strainer and a transparent sight gage. The horizontal, fluid-tight baffle divides the reservoir into two chambers to retain the hydraulic fluid over the engine-driven pump supply outlet during short periods of inverted flight. One of the spring-loaded flapper valves on the horizontal baffle permits flow from the upper chamber of the reservoir into the lower chamber when the fluid level in the lower chamber drops due to a system demand. Fluid from the utility system main return line enters the air separator and then passes into the lower chamber. A surge in the utility return line will open the other spring-loaded flapper valve and allow fluid to flow to the upper chamber of the reservoir. The vertical baffle prevents turbulence inside the reservoir. The reservoir has attaching points for the utility hydraulic system return, brake system return, engine-driven pump supply, reservoir drain, scupper drain and pressurizing air lines.



FJ-4B-2-58-2-C

Figure No. 3-20. Interchangeability of Utility Hydraulic Power System Engine-driven Pumps

### 3-22. REMOVING AND INSTALLING UTILITY HYDRAULIC POWER SYSTEM FLUID RESERVOIR.



#### REMOVING

- 1** Depressurize reservoir by actuating air manual relief valve (raising handle).
- 2** Exhaust pressure in nose gear emergency extension system.
- 3** Drain utility hydraulic system reservoir. (Refer to paragraph 3-13.)
- 4** Remove access panel covering reservoir compartment.
- 5** Remove air manual relief valve actuating lever.
- 6** Disconnect utility return, brake return, pressurizing air, scupper drain, engine-driven pump supply and reservoir drain lines from reservoir and cap all openings.

**Note** Engine-driven pump supply and reservoir drain lines are accessible through the right-hand engine access door. Use crowfoot to aid in disconnecting these lines.

- 7** Support the reservoir and remove two nuts attaching mounting straps on reservoir.
- 8** Lift reservoir from support and remove from airplane.

**Caution** When removing reservoir from compartment, care should be exercised to prevent damage to reservoir and adjacent hydraulic lines.

- 1** Lower reservoir into compartment until bottomed against mounting support.
- 2** Position mounting straps in beaded recess on reservoir and start nuts on bolts, attaching mounting straps together.

**Note** Make certain protective cushioning material covering mounting straps is in correct position to prevent chafing against reservoir.

- 3** Remove hydraulic cap and plugs. Connect five hydraulic lines and one air pressure line to reservoir.

**Note** Access to connect and tighten the pump suction and reservoir drain line is gained through engine access door just aft of reservoir compartment. Use crowfoot to aid in tightening these connections.

- 4** Install handle on air manual relief valve and secure with bolts, washers and nuts.
- 5** Tighten nuts attaching mounting straps together.
- 6** Service fluid reservoir. (See figures 3-14 through 3-16.)
- 7** Check utility hydraulic power system. (Refer to paragraph 3-5.)
- 8** Install access panel.

3-23. UTILITY HYDRAULIC POWER SYSTEM  
RESERVOIR AIR PRESSURIZATION SYSTEM.

3-24. The reservoir air pressurization system (figure 3-12) supplies the fluid reservoir with a differential pressure of 10 to 15 psig when the engine is operating to prevent engine-driven pump cavitation. The reservoir pressurizing system includes a filter, a pressure regulator and a manual relief valve. Air pressure between 15 and 120 psi is routed through the air filter to the pressure regulator from the engine compressor section. Engine compressor air pressure is bled for the reservoir pressurization system from the windshield anti-ice and de-foist duct. The pressure regulator maintains a differential pressure of 10 to 15 psig to the reservoir and permits outside air to enter the reservoir in the event air pressure inside the reservoir drops below atmospheric pressure due to a malfunction. The manual relief valve, when actuated, vents all air in the pressurizing system overboard, thus depressurizing the reservoir.

3-25. UTILITY HYDRAULIC POWER SYSTEM  
AIR PRESSURE REGULATOR.

3-26. The reservoir air pressure regulator is located in the utility hydraulic system reservoir compartment directly above and behind the reservoir in the air pressure supply line. The air pressure regulator controls and maintains a constant differential pressure of 10 to 15 psig inside the utility hydraulic power system reservoir when the engine is running. The pressure regulator receives the engine compressor air pressure and vents overboard all air except the amount required to pressurize the reservoir (10 to 15 psig). If the fluid level in the reservoir should increase with the retracting of the cylinders or the discharging of the nose gear emergency extension accumulator, the regulator relieves excessive air pressure at approximately 15 psig.

3-27. REMOVING UTILITY HYDRAULIC POWER  
SYSTEM AIR PRESSURE REGULATOR.

- a. Gain access to pressure regulator by removing the reservoir compartment access panel.
- b. Exhaust air pressure by operating manual relief valve.
- c. Disconnect five air lines from pressure regulator and air filter. Cap openings.

**Note**

The air filter and a check valve are attached to the pressure regulator; therefore, these units must be removed with the pressure regulator.

- d. Support pressure regulator and remove bolt and washer securing clamp to structure.
- e. Remove pressure regulator from reservoir compartment.

3-28. INSTALLING UTILITY HYDRAULIC POWER  
SYSTEM AIR PRESSURE REGULATOR.

- a. Position pressure regulator to connect in air pressure supply line so that check valve and air filter are facing forward.

**Note**

Make sure arrow on check valve and air filter are pointing aft. The word "VENT," stamped on pressure regulator housing, should be facing aft.

- b. Install bolt and washer securing clamp to inboard structure of reservoir compartment.
- c. Remove caps and connect five air lines to pressure regulator and air filter.
- d. Install reservoir compartment access panel.

3-29. UTILITY HYDRAULIC POWER SYSTEM  
AIR MANUAL RELIEF VALVE.

3-30. The air manual relief valve is located in the reservoir compartment above and to the left of the reservoir. The manual relief valve is incorporated in the air pressurizing system to manually exhaust air pressure in the reservoir and the air pressurizing system prior to maintaining or servicing the utility hydraulic system.

3-31. REMOVING UTILITY HYDRAULIC POWER  
SYSTEM AIR MANUAL RELIEF VALVE.

- a. Gain access to manual relief valve by removing the reservoir compartment access panel.
- b. Exhaust air pressure by operating manual relief valve.
- c. Disconnect air lines from manual relief valve and cap openings.
- d. Support manual relief valve and remove bolts, washers and nuts attaching valve to mounting bracket.
- e. Remove manual relief valve from reservoir compartment.

3-32. INSTALLING UTILITY HYDRAULIC POWER  
SYSTEM AIR MANUAL RELIEF VALVE.

- a. Position manual relief valve to fit on mounting bracket so that operating handle is over reservoir filler cap.
- b. Install bolts, washers and nuts attaching relief valve to mounting bracket and partially tighten.
- c. Remove caps and connect air lines to manual relief valve.
- d. Tighten bolts and nuts securing manual relief valve to mounting bracket.
- e. Install reservoir compartment access panel.

### 3-33. UTILITY HYDRAULIC POWER SYSTEM AIR FILTER.

3-34. The reservoir pressurizing system air filter is a line-type filter. It prevents foreign matter from entering the fluid reservoir through the air pressure supply line. The air filter is located above the reservoir in the air pressure regulator supply line. The stainless steel filter element may be removed for cleaning. (Refer to paragraph 3-52.)

### 3-35. REMOVING UTILITY HYDRAULIC POWER SYSTEM AIR FILTER.

- a. Exhaust air pressure by operating manual relief valve.
- b. Gain access to air filter by removing the hydraulic reservoir compartment access panel.
- c. Disconnect air line from filter and cap opening.
- d. Hold check valve stationary and remove filter from check valve.
- e. Remove air filter from reservoir compartment.

### 3-36. INSTALLING UTILITY HYDRAULIC POWER SYSTEM AIR FILTER.

- a. Position air filter on check valve so arrow is pointing aft.
- b. Hold check valve stationary and install air filter.
- c. Remove caps and connect air line to air filter.
- d. Install access panel.

### 3-37. UTILITY HYDRAULIC POWER SYSTEM PRESSURE RELIEF VALVE.

3-38. The pressure relief valve is installed between the utility hydraulic pressure and return lines to protect the utility hydraulic system against excessive pressures caused by fluid surges, thermal expansion and engine-driven pump automatic control failure. The relief valve is located in the gun air storage bottle compartment on the left-hand side of the fuselage. The relief valve is set to crack at 3450 ( $\pm 50$ ) psi. Full flow and reseal pressure are approximately 3750 and 3100 psi, respectively. The relief valve consists of a spring, a pilot piston, a pilot valve, a pilot valve lever and a main relief valve. (Refer to paragraph 3-39.) When excessive pressure is applied to the relief valve, the pilot piston overcomes spring tension and the pilot valve unseats. When the pilot valve unseats, it relieves trapped pressure on the upper side of the main relief valve. Pressure then unseats the main relief valve and fluid is returned to the reservoir through the return line. When pressure decreases, the pilot valve closes and pressure on the upper side of the main relief valve gradually builds up as fluid leaks by the valve seat. The main relief valve then slowly returns to the reseal position.

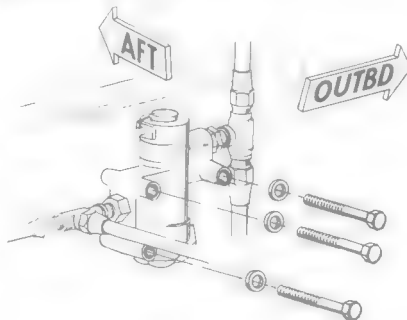
### 3-39. REMOVING, ADJUSTING AND INSTALLING UTILITY HYDRAULIC POWER SYSTEM PRESSURE RELIEF VALVE.



LH GUN AIR STORAGE BOTTLE COMPARTMENT (LOOKING AFT)

#### REMOVING

- 1** Depressurize utility hydraulic system reservoir.
- 2** Exhaust hydraulic pressure in nose gear emergency extension system.
- 3** Gain access to relief valve by removing the gun air storage access panel on left-hand side of fuselage.
- 4** Disconnect the four hydraulic lines from pressure and return ports of relief valve and cap openings.
- 5** Remove three mounting bolts and washers securing relief valve to mounting bracket.



- 6** Remove relief valve from airplane.

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## ADJUSTING

**1** Place relief valve in a clean container. Connect a pressure gage calibrated to indicate 4000 psi and a hand pump capable of producing 4000 psi to pressure port on relief valve.

**2** Bleed temporary system.

*Note* Hand pump should be connected to a clean supply of hydraulic fluid (item 95, materials list).

**3** Break safety wire on adjusting screw locknut.

**4** Hold adjusting screw stationary and back off locknut two to three full turns.

**5** Operate hand pump to build up pressure and observe gage carefully to determine when relief valve cracks and allows a small amount of fluid to flow from return port.

**6** Relieve pressure and adjust relief valve to crack at 3450 ( $\pm 50$ ) psi.



*Note* To increase relief valve cracking pressure, turn adjustment screw clockwise. To decrease cracking pressure, turn adjustment screw counterclockwise. Steps 5 and 6 may have to be repeated a number of times before the desired cracking pressure is obtained.

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**7** When relief valve setting is adjusted to desired cracking pressure, hold adjusting screw stationary and tighten locknut.

*Note* Cycle relief valve through its phase of operation at least five times to ensure correct setting.

**8** Safety locknut with AN995F32 lockwire.

**9** Remove hand pump and pressure gage from relief valve pressure port.

## INSTALLING

**1** Position relief valve on mounting bracket so return port is pointing down and facing inboard.

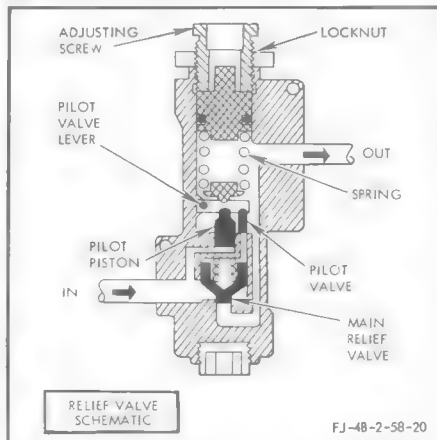
**2** Partially install three mounting bolts and washers.

**3** Remove caps and connect four hydraulic lines to pressure and return ports of relief valve.

**4** Tighten mounting bolts.

**5** Check utility hydraulic power system. (Refer to paragraph 3-5.)

**6** Install gun air storage access panel.



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3-40. UTILITY HYDRAULIC POWER  
SYSTEM EXTERNAL GROUND  
TEST CONNECTION PANEL.

3-41. External disconnect couplings for hydraulic suction and pressure are provided for connecting an external source of hydraulic power to the utility hydraulic power system. The external ground test connection panel, located on the lower right-hand side of the fuselage just forward of the field break, is accessible through the lower engine access door. Each self-sealing coupling is identified.

3-42. BRAKE SYSTEM PRIORITY VALVE.

3-43. The wheel brake system priority valve is installed in the utility hydraulic power system pressure line near the engine-driven pump. It is located on the forward right-hand side of the engine bay. Fluid to operate every subsystem, except the wheel brake system, in the utility system must pass through the priority valve. Brake pressure supply is obtained upstream of this unit. The priority valve is open only when pressure on the inlet port exceeds approximately 930 psi. Full flow is maintained at approximately 1080 psi. Reset pressure is approximately 800 psi. The priority valve contains two spring-loaded valves. One valve has unbalanced effective areas so that a sufficient pressure increase (930 psi) at the inlet port will force the valve open. The other valve is used to permit reverse free flow only.

3-44. UTILITY HYDRAULIC PRESSURE  
INDICATING SYSTEM.

3-45. A remote reading pressure indicating system is integrated with the No. 1 and No. 2 flight control hydraulic systems to provide visual indication of utility hydraulic system pressure when selected (figure 3-21). The pressure indicating system consists of a line-type snubber, a pressure transmitter, a dual reading pressure indicator and a momentary, rotary-type selector switch. The pressure snubber is installed in the pressure line to the transmitter to protect it against pressure surges. The pressure transmitter is a Bourdon tube, synchro-type transmitter that converts hydraulic pressure into increments of electrical energy. The dual reading pressure indicator is calibrated to match the electrical characteristics of the transmitter. When the momentary-type selector switch (HYD PRESS SELECTOR) is positioned to "UTILITY," hydraulic pressure, effective at the transmitter, is electrically converted and relayed to the indicator. Both indicator pointers align and register utility hydraulic system pressure in psi. If a-c power is lost due to power failure, the indicator pointers will remain at the last indication.

3-46. UTILITY HYDRAULIC PRESSURE INDICATING SYSTEM SNUBBER. The pressure snubber is installed in the pressure transmitter line to reduce pressure surges and to prevent the pointers at the indicators from oscillating. The snubber is located on the right-hand side of the fuselage, just forward of the gun deck. The snubber consists of a body with a movable slide. When pressure in the transmitter line is steady, the fluid flows through the restricted passageway and provides a small amount of pressurized fluid necessary to activate the transmitter. When a pressure surge occurs in the transmitter pressure line, the sliding valve will move back and forth to absorb the shock.

3-47. UTILITY HYDRAULIC PRESSURE INDICATING SYSTEM TRANSMITTER. The synchro-type pressure transmitter for the utility hydraulic power system is located in the forward hydraulic compartment on the right-hand side of the fuselage. The transmitter consists of a Bourdon tube, a synchro motor and a case. Movement of the Bourdon tube under pressure causes the synchro rotor to rotate, thus changing hydraulic pressure into increments of electrical energy. With a-c power applied and utility pressure selected, the rotors in the indicator are positioned electrically by the transmitter synchro rotor. (See figure 3-21.)

3-48. UTILITY HYDRAULIC PRESSURE INDICATING SYSTEM INDICATOR. The dual reading, synchro-type pressure indicator is located on the lower left-hand side of the instrument panel. The indicator consists of two synchro motors, a dial calibrated from 0 to 4000 psi, two pointers, a concentric shaft and a case. When "UTILITY" pressure is selected, both synchros are connected in parallel with the transmitter synchro. Both pointers align to indicate utility hydraulic system pressure.

3-49. UTILITY HYDRAULIC POWER SYSTEM  
RETURN LINE FLUID FILTERS.

3-50. Two micronic, line-type fluid filters are installed in the utility hydraulic power system to filter hydraulic fluid prior to its return to the reservoir. The filters are located just forward of the reservoir in the reservoir compartment along the forward and inboard wall. One filter is installed in the utility system return line and one is installed in the brake system return line. The utility system filter has a capacity of 6 gpm and the brake system filter has a capacity of 3 gpm. Each filter incorporates a by-pass relief valve that will unseat at a differential pressure of 50 ( $\pm 5$ ) psi and allow return fluid to flow directly to the reservoir in the event the filter becomes clogged. The filter elements may be removed and cleaned or replaced. (Refer to paragraph 3-52.)



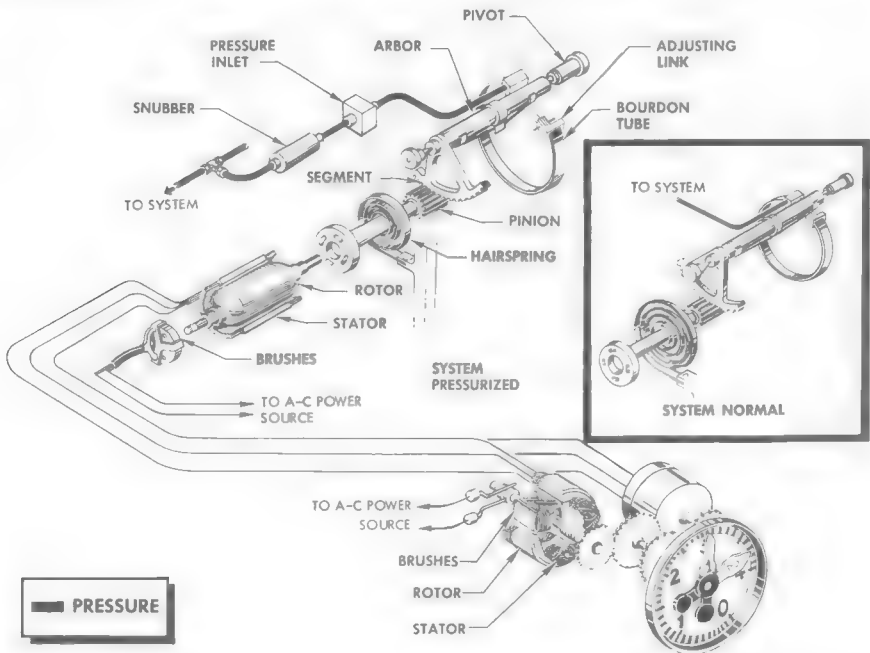
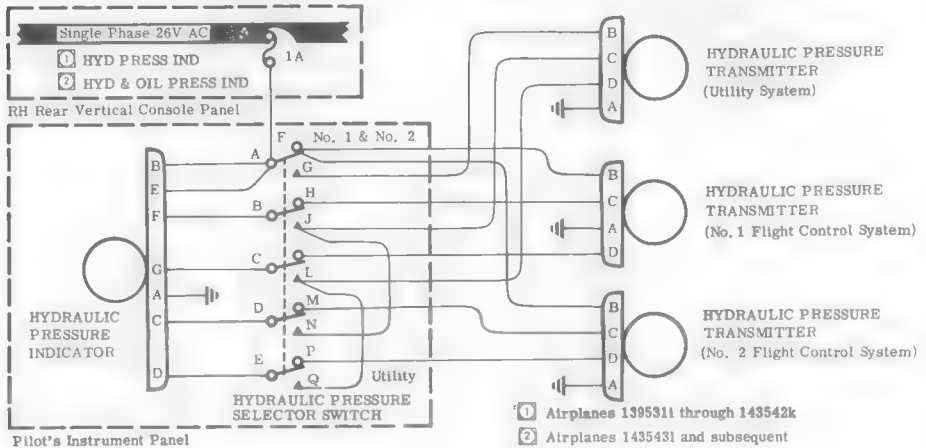
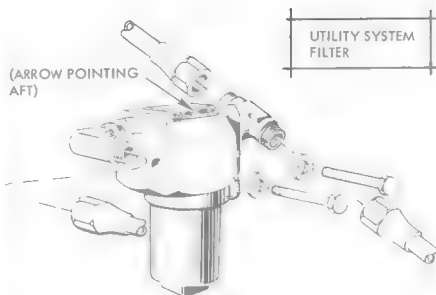
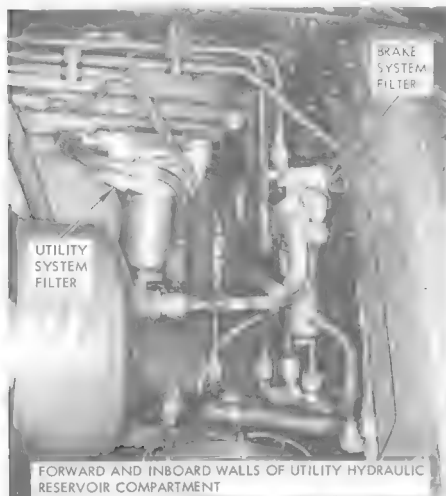


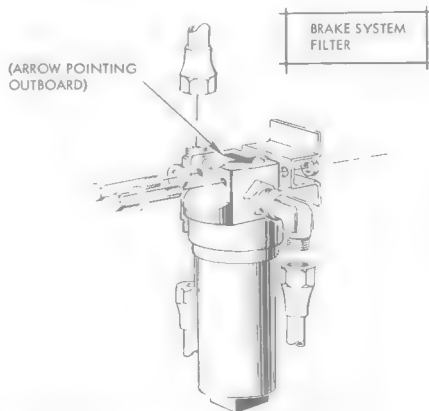
Figure No. 3-21. Utility Hydraulic Pressure Indicating System

### 3-51. REMOVING AND INSTALLING UTILITY HYDRAULIC POWER SYSTEM RETURN LINE FLUID FILTERS.



#### BRAKE SYSTEM FILTER

- 1 Position filter body on mounting bracket so that arrow on filter body is pointing outboard.
- 2 Install bolts, spacers, washers and nuts securing filter body to mounting bracket and partially tighten.
- 3 Remove caps and connect three hydraulic lines to filter body.
- 4 Tighten bolts and nuts securing filter body to mounting bracket.



#### REMOVING (typical for both filters)

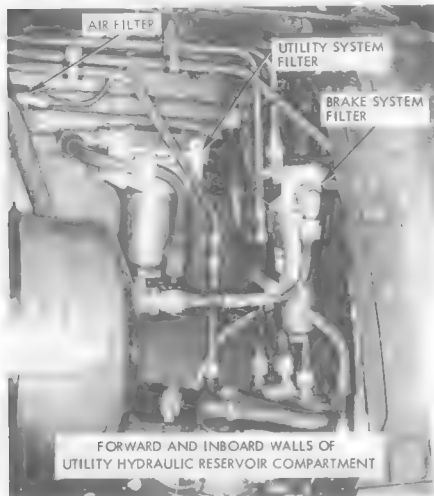
- 1 Dump nose gear emergency extension system pressure.
- 2 Depressurize fluid reservoir.
- 3 Remove utility hydraulic system reservoir compartment access panel.
- 4 Drain reservoir until fluid level is below return lines. (Refer to paragraph 3-13.)
- 5 Disconnect three hydraulic lines at filter body inlet and outlet ports and cap openings.
- 6 Support filter body and remove two mounting bolts, spacers, washers and nuts securing filter to bracket.
- 7 Remove filter from airplane.

#### INSTALLING

##### UTILITY SYSTEM FILTER

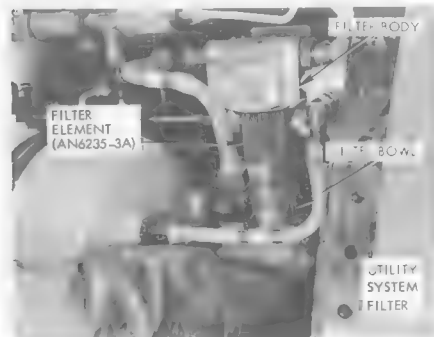
- 1 Position filter body on mounting bracket so that arrow on filter body is pointing aft.
- 2 Install bolts, spacers, washers and nuts securing filter body to mounting bracket and partially tighten.
- 3 Remove caps and connect three hydraulic lines to filter body.
- 4 Tighten bolts securing filter body to mounting bracket.

- 5 Check utility hydraulic power system. (Refer to paragraph 3-5.)
- 6 Install access panel.

3-52. REMOVING, CLEANING AND REPLACING  
UTILITY HYDRAULIC POWER SYSTEM FLUID  
FILTER ELEMENTS.

## REMOVING

- 1 Gain access to utility system, brake system, and reservoir air filters by removing reservoir compartment access panel.
- 2 Exhaust air pressure by operating manual relief valve and dump nose gear emergency extension accumulator.

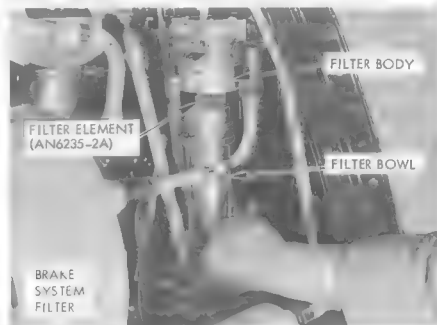


- 3 Prepare to catch residual hydraulic fluid.
- 4 Break safety wire and remove filter bowl.

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- 5 Remove filter element from filter body by gently rocking element back and forth while exerting a pulling tension.

**Caution** Do not remove filter element with a twisting motion.



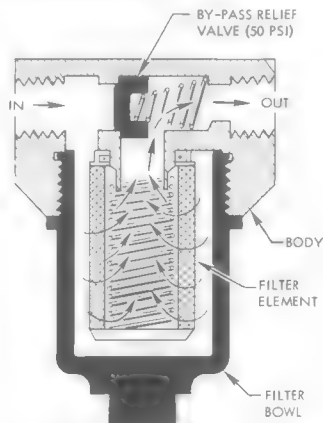
- 6 Inspect filter element carefully to determine condition. If filter is unfit for use, discard and replace with new element if available.

**Note** If a replacement element is not available, the filter element may be cleaned as follows:

## CLEANING

- 1 Use a solution of 50 percent lacquer thinner (item 76, materials list) and 50 percent toluene (item 132, materials list).

**Caution** Do not breathe fumes of cleaning solution or use solution near a fire of any kind. The cleaning solution is extremely volatile and should be used in a well ventilated area.



FLUID FILTER SCHEMATIC

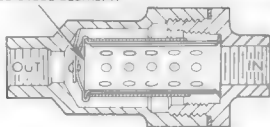
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- 2** Clean exterior convolutions of filter element with a soft bristle brush and a mild air blast.

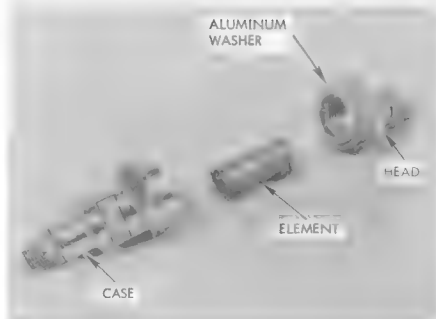
**Note** Do not use a hard bristle brush or scraper to clean convolutions of filter elements; they may cause damage to the element.



STAINLESS STEEL ELEMENT



AIR FILTER SCHEMATIC



- 3** Allow element to dry thoroughly; then inspect element for condition and cleanliness.
- 4** Clean interior of filter bowl.

### REPLACING

- 1** Place filter element in filter bowl and install. Safety filter with AN995 F32 lockwire.

**Note** Do not tighten filter bowls excessively; hand-tight is usually sufficient. If filter leaks around bowl after being tightened, replace "O" ring (AN6230-1) and backup rings (AN6244-1) in brake system filter body and replace "O" ring (AN6230-4) and backup rings (AN6244-4) in utility system filter body.

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**WING FOLD SYSTEM****3-53. WING FOLD SYSTEM.**

3-54. Selection of wing folding or spreading is through a four-port, solenoid-operated selector valve. The wing fold selector switch in the cockpit is protected by a manual lockpin handle to prevent operation of the switch with the lockpins mechanically locked. The switch is accessible after the manual lockpin handle is released and pulled down. Utility hydraulic system pressure is utilized by the wing fold components. The lockpin cylinders and the wing fold actuating cylinders are hydraulically and mechanically sequenced and electrically controlled. Restrictors are installed in the fold and spread lines to control speed of operation. The wing fold hydraulic system consists of a wing fold selector switch, a solenoid-operated valve, a lock valve, two controllable check valves, two priority valves, two lockpin cylinders and two wing fold actuating cylinders.

**3-55. FUNCTION OF WING FOLD SYSTEM — FOLDING CYCLE.**

3-56. Movement of the manual lockpin handle to the down position causes two attached teleflex cables to unlock the lockpin locks, raise a warning flag on the upper surface of each inner wing panel and center the aileron controls. It should not be necessary to exert undue force on the manual lockpin handle if pressure is on the hydraulic systems. If there is no pressure, thermal expansion may be causing the lockpins to bind. This condition can be alleviated by depressing the lever on the lock valve. The landing gear handle must be "DOWN" and the airplane's weight on the landing gear to fold the wings. Positioning the wing fold selector switch to "FOLD" completes a circuit to the fold solenoid of the selector valve. Hydraulic pressure then flows through the

lock valve to the lockpin cylinders. When the pistons in the lockpin cylinders have bottomed in the unlocked position, pressure build-up unseats the priority valves in the wing fold lines and allows fluid to enter the wing fold cylinders. This sequence prevents the wing fold cylinders from extending before the lockpins are retracted.

**CAUTION**

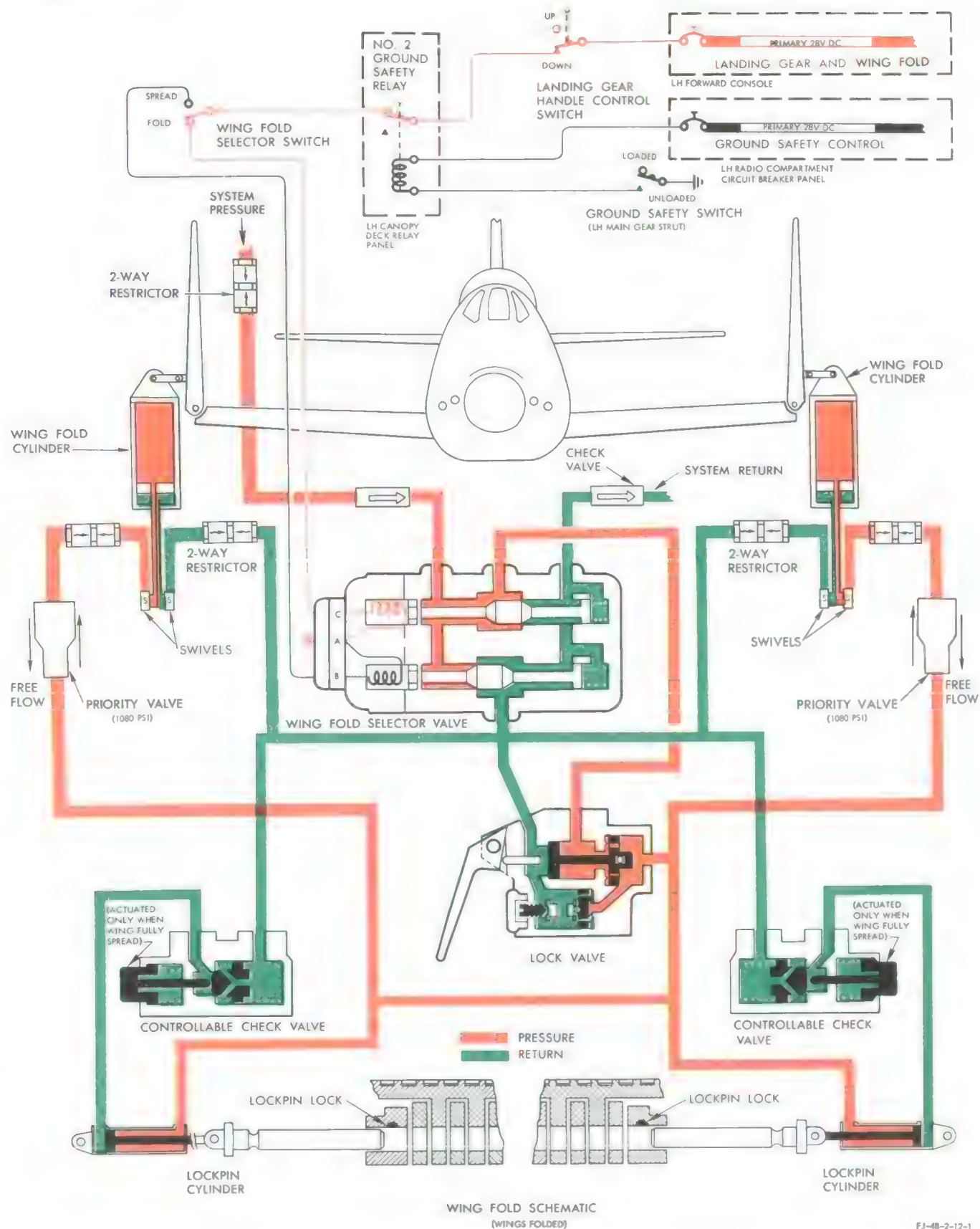
Folded wings can be structurally damaged by gusts of wind exceeding 60 knots. Always install wing jury struts when parking airplane with folded wings.

**3-57. FUNCTION OF WING FOLD SYSTEM—SPREADING CYCLE.**

3-58. Positioning the wing fold selector switch to "SPREAD" completes a circuit to the spread solenoid of the selector valve. Hydraulic pressure then flows to the spread end of the actuating cylinders; this pressure unseats the lock valve and, as the wings are spreading, fluid from the fold end of the actuating cylinder can flow through the return line. As each wing panel reaches the spread position, an adjustable actuating bolt depresses the plunger on the controllable check valve; pressure is then ported to the lockpin cylinders. When the lockpins are fully extended and the manual lockpin handle in the cockpit is moved to its up position, each lockpin is held by a rod that rotates into an annular groove in the lockpin. The preceding operation lowers the warning flag on each wing and releases the aileron control centering mechanism.

Section III  
Wing Fold System

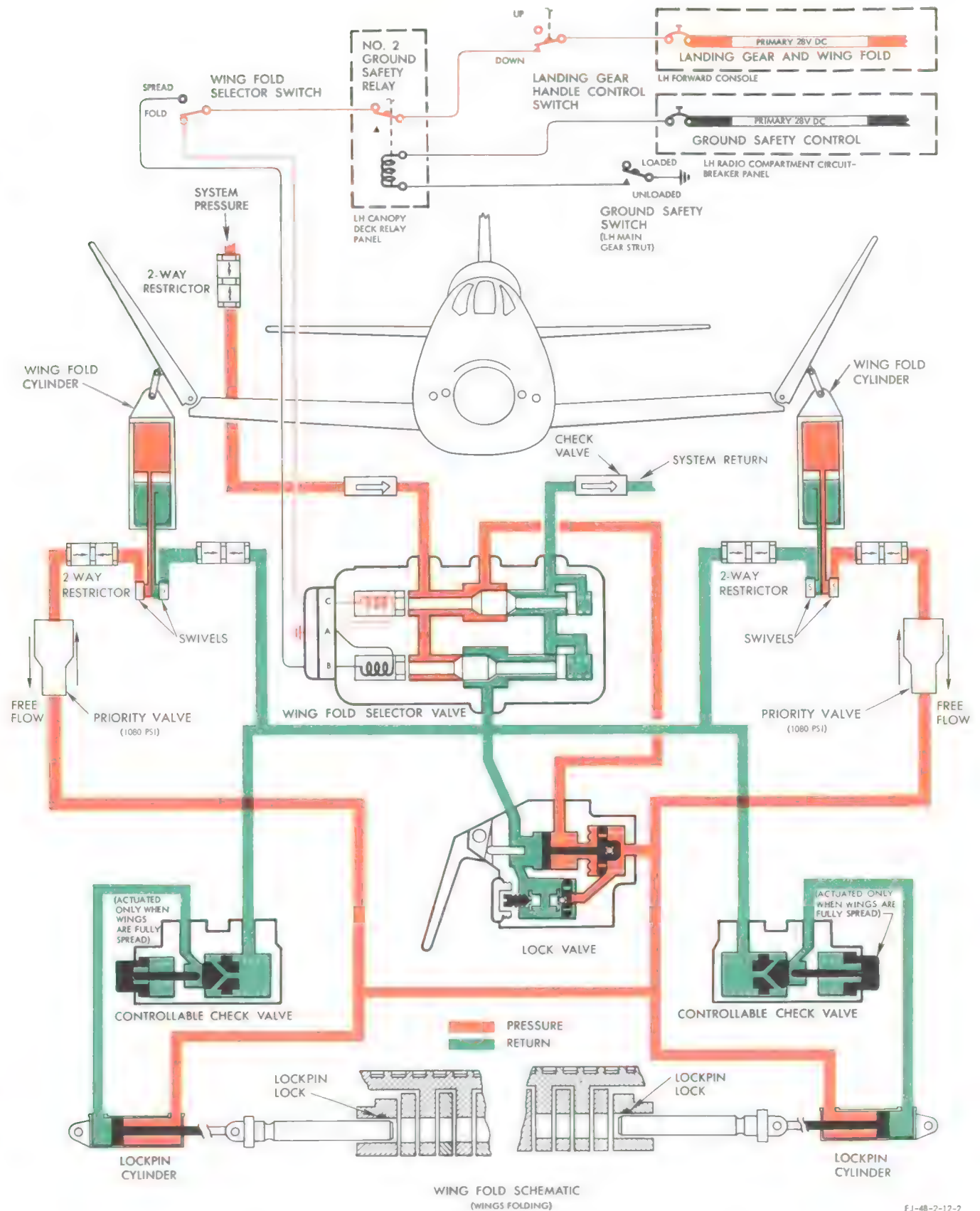
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Figure No. 3-22. Wing Fold System Schematic—Wings Folded





FJ-48-2-12-2

Figure No. 3-23. Wing Fold System Schematic—Wings Folding

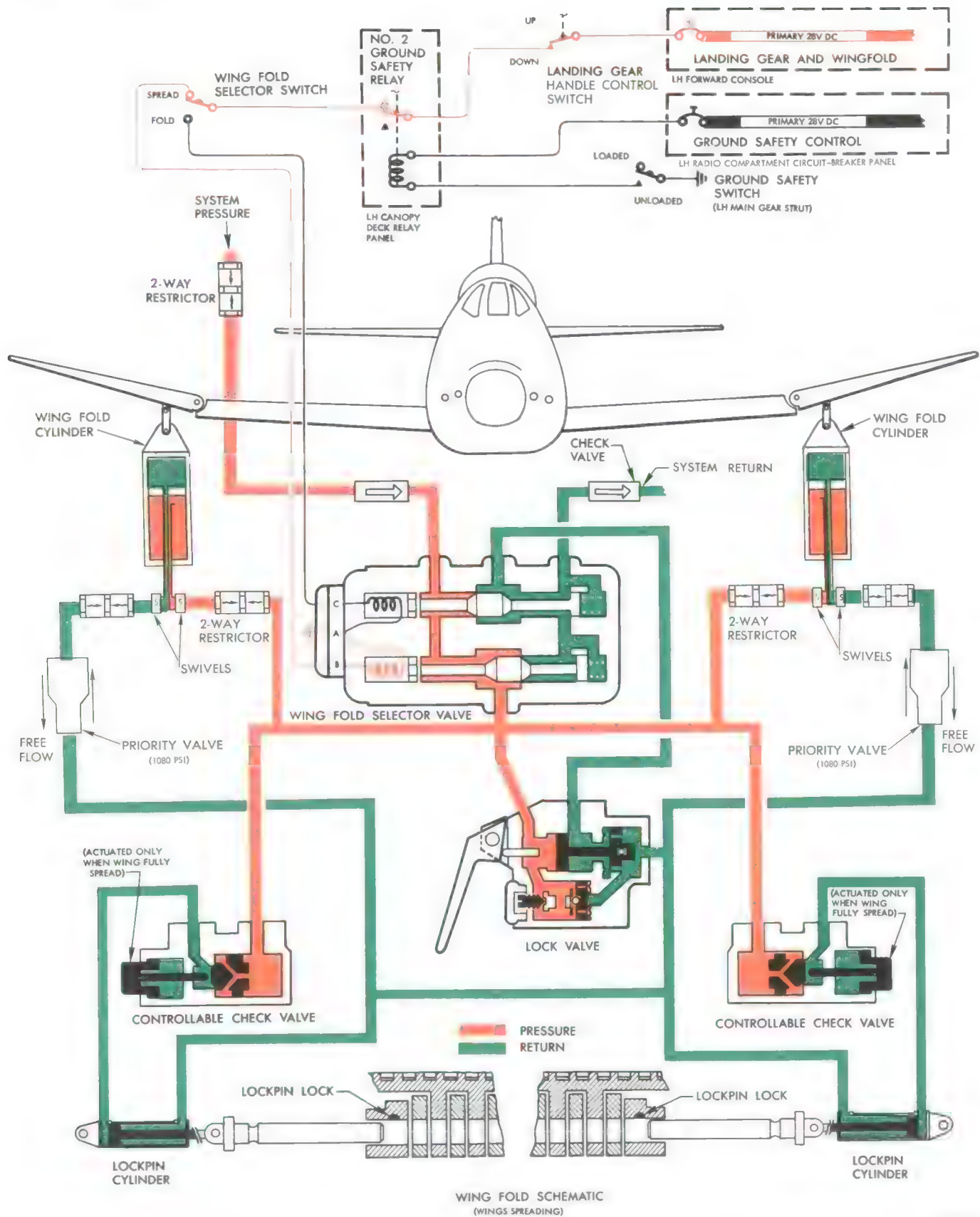
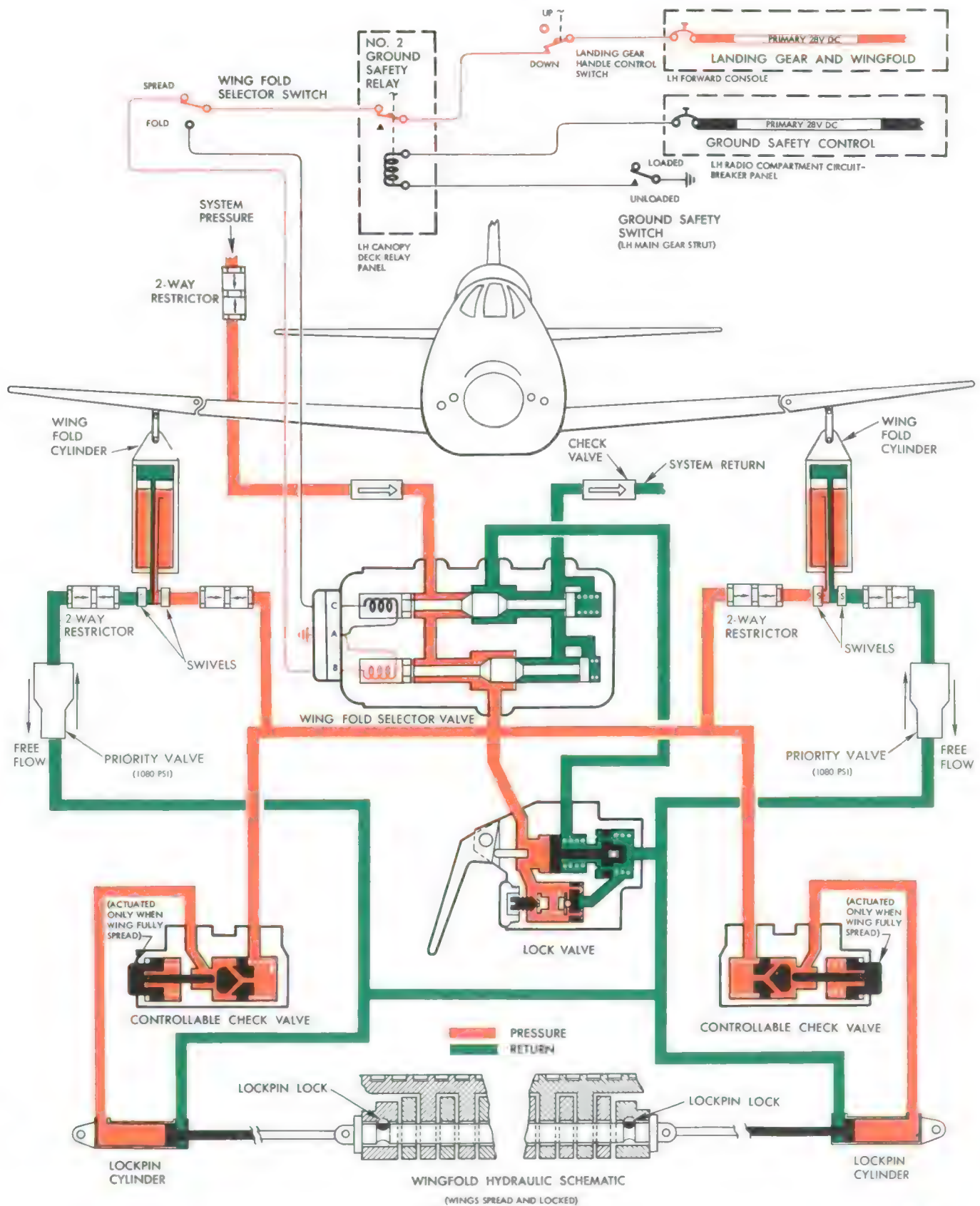


Figure No. 3-24. Wing Fold System Schematic—Wings Spreading





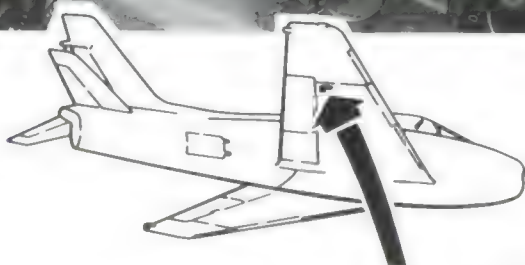
FJ-48-2-12-4

Figure No. 3-25. Wing Fold System Schematic—Wings Spread

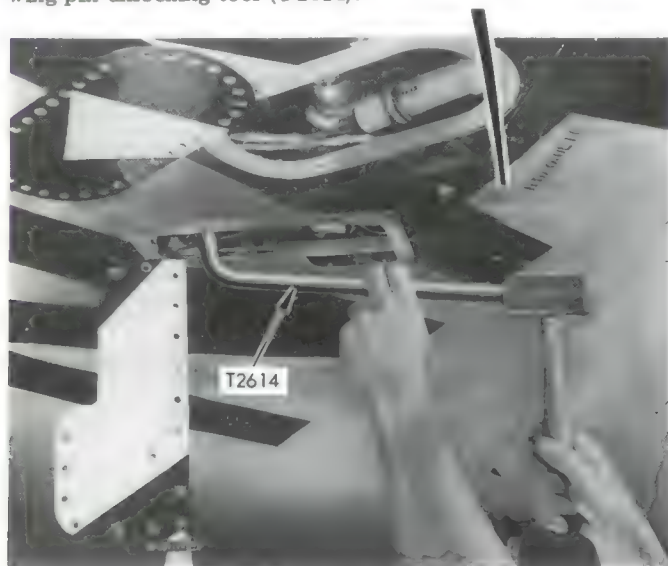
### 3-59. MANUALLY FOLDING AND SPREADING WINGS.

#### FOLDING

- 1** Pull out landing gear control and wing fold control circuit breakers on left-hand console.
- 2** Pull manual lockpin handle to full down position.



- 3** Access to the lockpins is through the wing fold lower access door. Unlock the pins by means of a wing pin unlocking tool (T2614).



- 4** Manually fold wings and install jury struts.

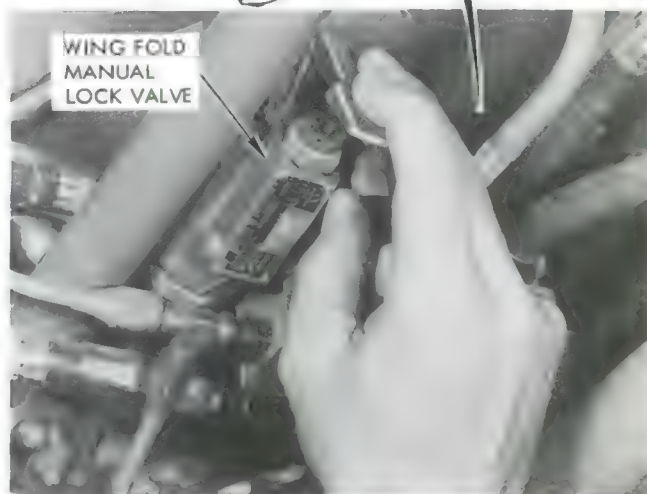
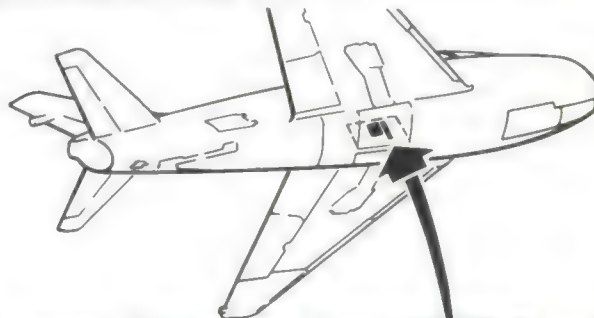
**Caution** Do not release wing panels from folded position until jury struts are installed.  
FJ-4B-2-12-5A

#### SPREADING

- 1** Remove jury strut.



- 2** Located near the centerline of the airplane in the left-hand wheel well is the wing fold lock valve. Depress the lever on this valve.



- 3** Manually spread the wings.

**Warning** The wing panel may drop and cause structural damage if there is no hydraulic pressure in the lines. Provide support for the panel until certain that pressure is present.

**Note** The lockpins will not extend after manually spreading wings until hydraulic pressure is applied.

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## 3-60. TROUBLE SHOOTING WING FOLD SYSTEM.

**CAUTION**

Bleed wing fold system after performing any maintenance on the hydraulic components.

**TEST EQUIPMENT:** D-C voltmeter.

**SYSTEM CONDITIONS:** Airplane on ground, weight on wheels and 28-volt d-c power applied to airplane.  
Hydraulic test stand capable of 13 gpm at 3000 psi connected to airplane.  
Pressure removed during trouble shooting.  
LG. & WING FOLD and GROUND SAFETY & OVERVOLTAGE circuit breakers engaged.

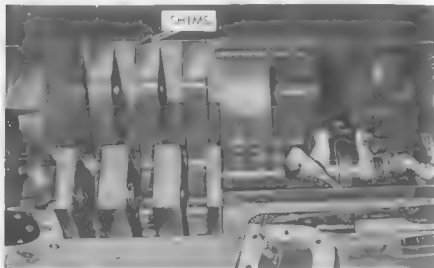
PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
WINGS FAIL TO SPREAD; CONTROL SWITCH AT "SPREAD" POSITION.			
Defective lock valve.	Wings fail to spread manually.		Replace lock valve. (Refer to paragraph 3-72.)
Defective actuating cylinder.	Low utility system pressure when spread is selected.		Replace actuating cylinder. (Refer to paragraph 3-78.)
Spread solenoid in selector valve not operating.	Check test point GDA to ground.	28 volts dc.	Replace wire segment to valve or defective valve. (Refer to paragraph 3-71.)
		Zero volts.	Continue trouble shooting procedure.
	Check test point GBD to ground.	28 volts dc.	Replace defective control switch or attached wiring.
		Zero volts.	Continue trouble shooting procedure.
	Check test point GDC to ground.	28 volts dc.	Replace defective GROUND SAFETY RELAY NO. 2 or attached wiring.
		Zero volts.	Continue trouble shooting procedure.
	Check test point GAD to ground.	28 volts dc.	Replace defective wire segment.
		Zero volts.	Replace landing gear control handle switch or power wire.
Malfunction in ground safety circuit.	Check between test points GM and GDE.  Note Test point GM is positive.	Zero volts.	No action.
		28 volts dc.	Rig or replace ground safety switch.
WINGS FAIL TO FOLD; CONTROL SWITCH AT "FOLD" POSITION.			
Fold solenoid in selector valve not operating.	Check test point GDF to ground.	28 volts dc.	Replace wire segment to valve or defective valve. (Refer to paragraph 3-71.)
		Zero volts.	Continue trouble shooting procedure.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>WINGS FAIL TO FOLD; CONTROL SWITCH AT "FOLD" POSITION. (Cont)</b>			
Fold solenoid in selector valve not operating.	Check test point GBD to ground.	28 volts dc.	Replace defective switch or attached wiring.
		Zero volts.	Continue trouble shooting procedure.
<b>POWER FAILURE.</b>			
Defective circuit breaker.	Check test points PDA and PGR to ground.	28 volts dc.	Replace circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.
<b>WINGS FAIL TO LOCK IN SPREAD POSITION.</b>			
Controllable check valve actuating bolt incorrectly adjusted.	Check that actuating bolt depresses plunger on valve.		Adjust actuating bolt. (Refer to paragraph 3-73.)
Defective controllable check valve.	No hydraulic pressure in lockpin cylinder with plunger on valve depressed.		Replace valve. (Refer to paragraph 3-73.)
Defective lockpin cylinder.	Excessive heat or noise at cylinder.		Replace lockpin cylinder. (Refer to paragraph 3-79.)
Internal leak in lockpin cylinder.	Utility system pressure drops when wings reach spread position.		Replace lockpin cylinder. (Refer to paragraph 3-79.)
<b>WINGS FAIL TO LOCK MECHANICALLY.</b>			
Lockpin lock teleflex cables not properly rigged.	Handle in cockpit cannot be fully actuated or requires more than 35 pounds to actuate.		Rig teleflex cables. (Refer to paragraph 3-84.)
<b>WINGS FOLD OR SPREAD TOO RAPIDLY.</b>			
Air in lines.	Uneven folding or spreading.		Bleed wing fold system. (Refer to paragraph 3-63.)
Defective restrictors.	One or both wings drop rapidly.		Replace restrictors.
<b>UNABLE TO UNLOCK MANUAL LOCKPIN HANDLE.</b>			
Thermal expansion in unlocked side of lockpin cylinders.	Unable to actuate manual lockpin handle to down position.		Operate lever on lock valve.

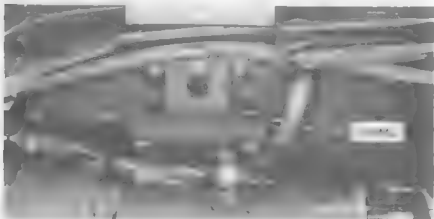
## 3-62. ADJUSTING MAIN SPAR LOCK FITTINGS.

**Note** Maximum allowable hydraulic pressure to extend or retract the wing fold lockpin piston assembly with the wing in the spread position is 300 psi. If the maximum pressure is exceeded, check the alignment of the main wing spar lock fittings.

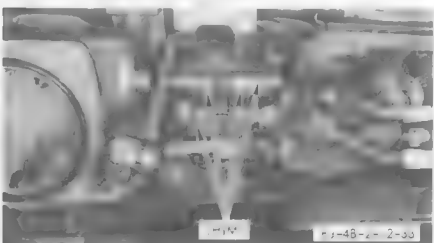
- 1 To adjust main wing spar lock fittings, insert or remove stainless steel shims on outboard wing panel butt rib until lock fittings are in alignment.



- 2 For adjusting front spar to torque fitting, stainless steel shims are used to attain zero to 0.010-inch clearance between the bottom of the spar and top of the torque fitting.



- 3 The aft spar is adjusted to its torque fitting at three places: top, bottom and end. The permissible clearance at all three locations is zero to 0.010 inch. Stainless steel shims should be installed or removed to remain within the specified tolerance.



## 3-63. BLEEDING WING FOLD SYSTEM.

3-64. No vents or drains are required to bleed air from the wing fold hydraulic lines. Normal operation of the system will clear the lines after a sufficient number of cycles. To bleed the system, proceed as follows:

- a. Connect hydraulic test stand to airplane. Set for 13 gpm at 3000 psi.
- b. Connect external electrical power source to airplane.
- c. Check for landing gear handle "DOWN" and ground safety switch loaded.
- d. Fold and spread wings through a minimum of five cycles or until smooth operation is obtained.

## 3-65. WING FOLD SELECTOR VALVE.

3-66. The wing fold selector valve is a piloted solenoid-type valve having four ports: pressure, return, cylinder No. 1 and No. 2. The unit contains a spool for each cylinder port. Each spool has two positions: normal and energized. When the solenoid is de-energized, hydraulic forces on the spool are balanced and it is forced to the normal position by a spring. The related cylinder port is then open to return. Energizing the solenoid moves the pilot valve, causing pressure on the spring side of the spool to be dumped through a passageway and through the clearance around the top of the solenoid plunger. Then, pressure easily overcomes spring force, moving the spool to the energized position. In this type of valve, the spool is moved by hydraulic pressure and thus the valve cannot be moved from the normal position by electrical power alone. This valve is installed on the right-hand side of the forward bulkhead in the engine bay.



Figure No. 3-26. Wing Fold Selector Valve

## 3-67. WING FOLD LOCK VALVE.

3-68. The wing fold lock valve traps hydraulic fluid in the fold line and locks the wings in a folded position when the jury struts are not installed. (If the wings have been folded manually, the lock valve will not be effective.) The lock valve consists of a controllable check valve, a manual spreading lever and a thermal relief valve. The controllable check valve allows free flow in the fold line during fold operation but normally prevents reverse flow. The check valve must be unseated



for the wings to spread; this can be accomplished manually by depressing the spread lever on the valve or hydraulically by means of a special piston and plunger incorporated in the valve's internal mechanism. When the selector valve ports pressure into the spread lines, pressure is also applied to the lock valve piston. Movement of the piston unseats the check valve, allowing return flow in the fold lines. The thermal relief valve prevents excessive pressure build-up between the lock valve and the wing fold actuating cylinders due to thermal expansion. The lock valve is located near the centerline of the airplane in the left-hand wheel well.

### 3-69. WING FOLD CONTROLLABLE CHECK VALVES.

3-70. Controllable check valves are provided to ensure operation of the wing fold lockpins after the wings are spread. The controllable check valves are in the lock line of the lockpin actuating cylinders and function as conventional check valves until their plunger is depressed when the wings are fully spread. With the plunger depressed, the valves are open to fluid flow in either direction. The pressure operated priority valves in the wing fold lines, set at 1000 psi, ensure the lockpins being unlocked before the wings commence to fold.

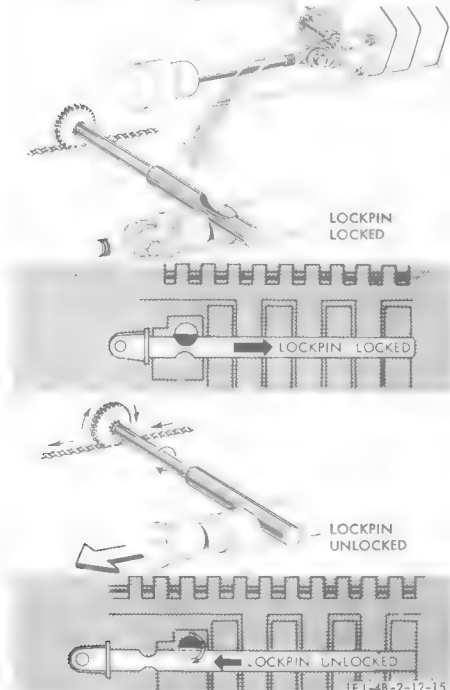
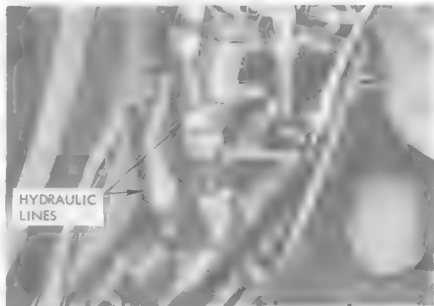


Figure No. 3-27. Wing Fold Lockpin Lock

### 3-71. REMOVING AND INSTALLING WING FOLD SELECTOR VALVE.

#### REMOVING

- 1 Remove fuselage aft section. (Refer to paragraph 2-6.)
- 2 Remove engine. (Refer to paragraph 5-7.)
- 3 Disconnect two hydraulic lines inboard of valve at their lower couplings.



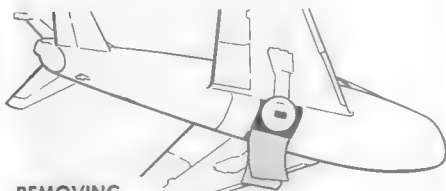
- 4 Disconnect four hydraulic lines from aft face of valve; then remove electrical leads.



- 5 Remove four bolts and withdraw valve.



## 3-72. REMOVING AND INSTALLING WING FOLD LOCK VALVE.

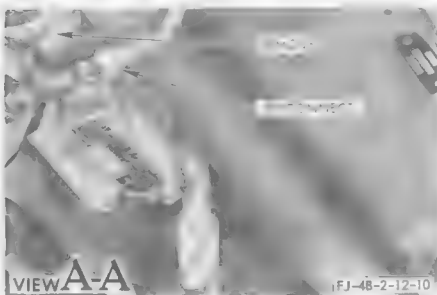


## REMOVING

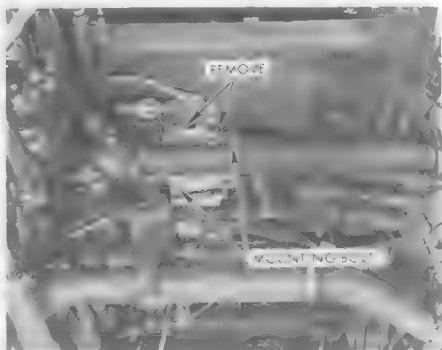
- 1 Manually open landing gear fairing doors. (Refer to paragraph 3-104.)



- 2 Disconnect hydraulic line below aft end of lock valve to gain wrench access to valve.



- 3 Remove one hydraulic line at aft face of lock valve and one at top of valve.
- 4 Remove two mounting bolts, nuts and washers securing valve to mounting bracket.



- 5 Pull valve down and forward to remove.

## INSTALLING

- 1 Position valve to mounting bracket and install mounting bolts, nuts and washers.
- 2 Connect hydraulic lines to valve.
- 3 Replace AN985F41 safety wire.



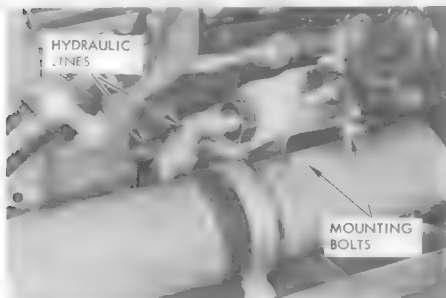
- 4 Connect hydraulic line disconnected in step 2 of removal procedures.
- 5 Check physical security of installation.

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### 3-73. REMOVING AND INSTALLING WING FOLD CONTROLLABLE CHECK VALVE.

#### REMOVING

- 1** Fold wings and install jury struts.
- 2** Remove wing fold lockpin. (Refer to paragraph 3-79.)
- 3** Remove two hydraulic lines from valve.
- 4** Remove two mounting bolts, nuts and washers.



- 5** Lift valve free.

#### INSTALLING

- 1** Install valve with two mounting bolts, nuts and washers.
- 2** Connect two hydraulic lines.

FJ-48-2-12-12



- 3** Install wing fold lockpin. (Refer to paragraph 3-79.)
- 4** Check physical security of installation and wing fold system.
- 5** Check wing fold system. (Refer to paragraph 3-61.)

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### 3-74. WING FOLD ACTUATING CYLINDER.

3-75. The wing fold cylinder is a sliding piston-type actuator. It consists of a drilled piston assembly, a barrel head assembly, a cylinder end, a drilled rod assembly, "O" rings, backup rings, felts and swivel assemblies. The piston rod has two drilled holes for the passage of hydraulic fluid. One hole extends through the piston head for passage of hydraulic pressure to the fold side of the cylinder. The other hole extends through the piston rod into the spread side of the cylinder. A swivel is attached to each side of the piston rod assembly at the mounting bracket on the inboard wing panel.

### 3-76. WING FOLD LOCKPIN CYLINDER.

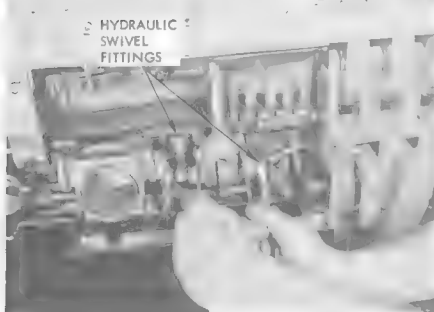
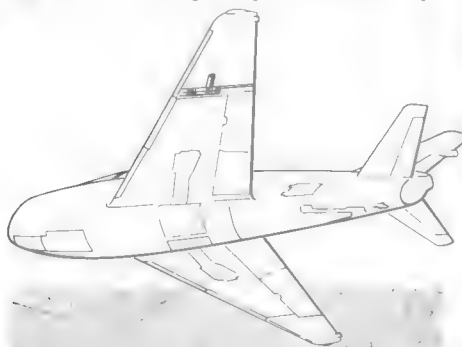
3-77. The wing fold lockpin cylinder provides a positive lock for the wings in the spread position. The cylinder consists of a sliding piston assembly, a cylinder and "O" rings, backup rings and felts. The lockpin is attached to the cylinder piston. When hydraulic pressure is ported to the lock side of the cylinder, the piston will extend, sliding the lockpin through the wing spar lock fittings. The lockpin has an annular recess near the head to accommodate a mechanically actuated lockpin lock. When the lockpin is fully extended, the mechanical lockpin lock can be rotated into the annular recess by raising the manual lockpin handle in the cockpit.



3-78. REMOVING AND INSTALLING WING FOLD  
ACTUATING CYLINDER.

## REMOVING

- 1** Remove swivel fittings from piston rod end assembly.



- 2** Remove piston rod retaining pin and unscrew end assembly from piston rod.



- 3** Push piston rod as far into cylinder as possible.



- 4** Remove bolt holding cylinder to mounting bracket in wing panel.



- 5** Remove cylinder through access door in outboard wing panel.



### 3-79. REMOVING AND INSTALLING WING FOLD LOCKPIN CYLINDER.

#### REMOVING

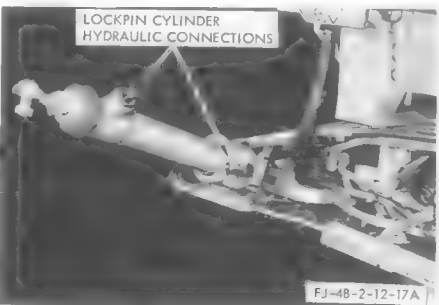
- 1** Fold the wings and install the jury strut.
- 2** Remove two hydraulic lines on the inboard side of the lockpin cylinder.
- 3** Telescope dust covers.



- 4** Disconnect lockpin from lockpin piston.



- 5** Rotate lockpin cylinder outboard; then remove lockpin and dust covers.



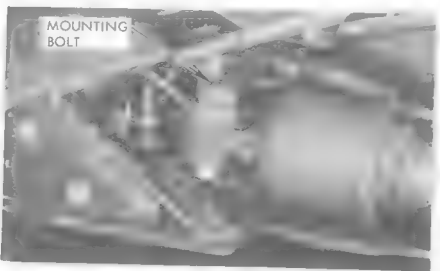
- 6** Remove mid-section of leading edge. (Refer to paragraph 2-14.)
- 7** Remove lockpin cylinder mounting bolt and remove cylinder.

#### INSTALLING

- 1** Insert lockpin in wing fold and install telescoped dust cover.



- 2** Position lockpin cylinder to mounting bracket and install bolt, nut, washer and cotter pin.



- 3** Connect and safety lockpin and lockpin piston.
- 4** Connect hydraulic lines to lockpin cylinder.
- 5** Separate telescoped dust cover and position on rub bands of lockpin cylinder. Install clamps over bands.
- 6** Check physical security of entire installation.
- 7** Install mid-section of leading edge. (Refer to paragraph 2-14.)
- 8** Check wing fold system. (Refer to paragraph 3-61.)

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## 3-80. WING FOLD TELEFLEX CABLE.

3-81. After the wings are spread and the lockpins extended, additional safety is provided by mechanical lockpin locks which, when engaged, secure the lockpins in their extended position. The lockpin lock is engaged and disengaged by a teleflex cable connected to a control handle in the cockpit. In addition, the teleflex cable positions a warning flag on the upper surface of each inner wing panel and operates an aileron control centering mechanism in the left-hand gun bay. Raising and lowering the lockpin control handle produces linear travel of the teleflex cables. Rotary motion to operate the lockpin locks, the warning flags and the aileron centering mechanism is provided by teleflex gear boxes. Each teleflex section consists of flexible steel cable contained in stainless steel tubing. Flag position adjustment is provided by an elongated hole in the flag shaft drive lever

and a serrated washer which locks the link attaching bolt in position. The aileron control centering mechanism prevents stick movement which would cause interference between the ailerons and the outboard wing panels when the wings are folded. The wing fold selector switch is not accessible until the mechanical lockpin control handle has been placed in the unlocked position.

## 3-82. AILERON CENTERING MECHANISM.

3-83. The aileron control centering mechanism, located in the left-hand gun bay, consists of a cam driven by a teleflex gear box. When the manual lockpin control handle is lowered, the cam rotates and positions the aileron controls to neutral. Flight control hydraulic pressure must be available to center the ailerons, if the ailerons are trimmed out of neutral, before the manual lockpin control handle can be fully actuated.

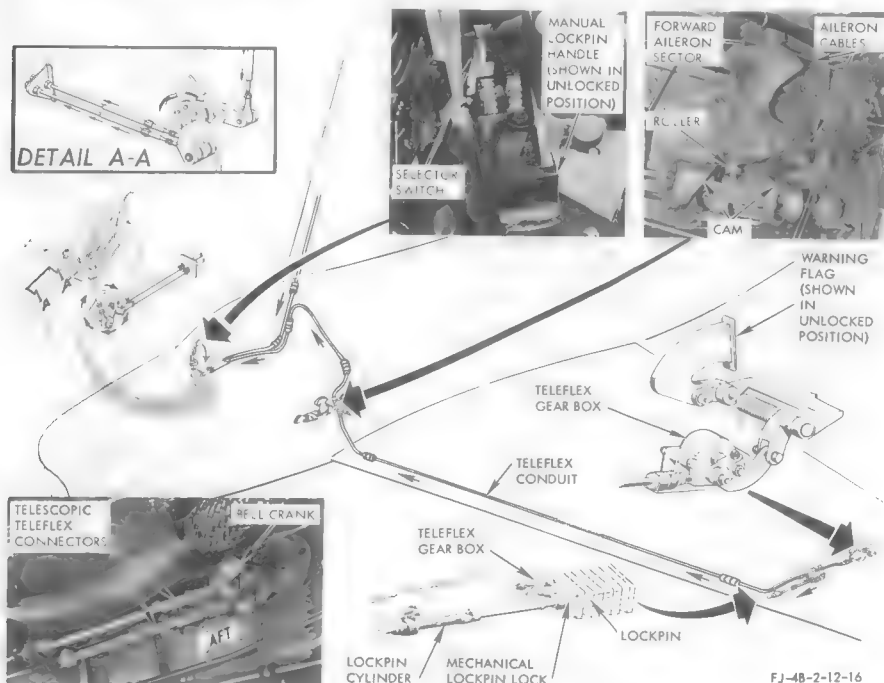


Figure No. 3-28. Wing Fold Teleflex Cable

FJ-48-2-12-16

### 3-84. REMOVING, INSTALLING AND RIGGING TELEFLEX CABLE.

#### REMOVING

- 1** Connect a 28-volt d-c external power source.
- 2** Connect a hydraulic test stand to the utility system. Adjust test stand for 5.5 gpm at 3000 psi.



- 3** Fold wings and install jury struts.



- 4** Adjust hydraulic test stand for minimum output.

FJ-48-2-12-19

- 5** Place wing fold selector switch in "SPREAD" position.

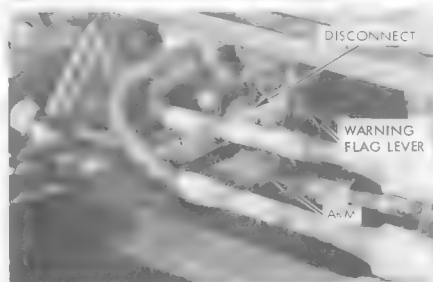
- 6** Depress controllable check valve plunger on right-hand wing. Maintain pressure on plunger until the lockpin is completely extended and replaces the lower jury strut lockpin.



- 7** Perform removal step 6 on left-hand wing.

- 8** Disconnect external power and test stand.

- 9** Disconnect arm at left-hand wing warning flag lever arm by removing bolt, nut and washers.



- 10** Remove nut and washer securing arm to gear box spline shaft.



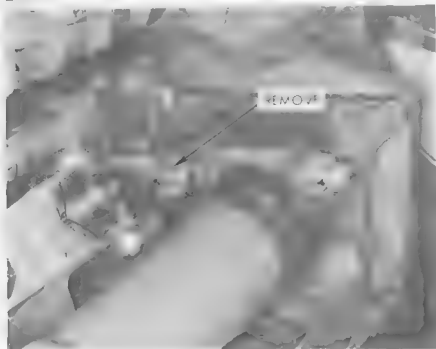
- 11** Loosen nut locking arm to splines.



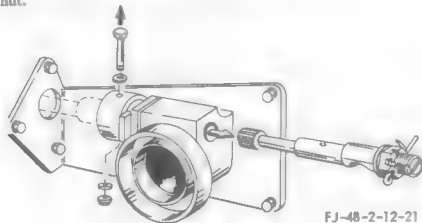
- 12** Remove disconnected linkage.

- 13** Replace nut and washer removed in step 10.

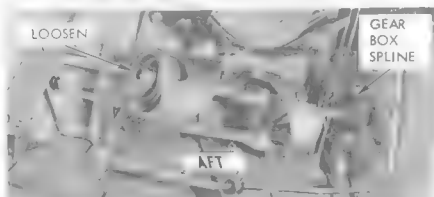
- 14** Remove wing fold mechanical lock.



- 15** Pull mechanical lock outboard, free of gear box spline and lockpin lock housing, without removing nut.



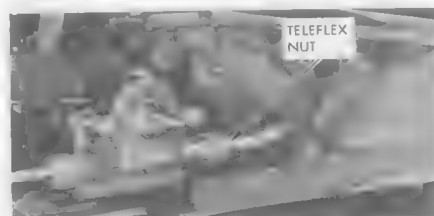
- 16** Remove cover around aileron centering mechanism; then loosen nut securing centering mechanism to its mounting bracket. Pull mechanism forward to disengage gear box spline.



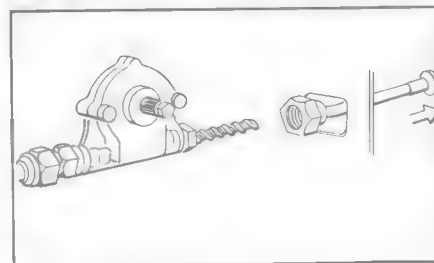
- 17** Loosen locknuts to free teleflex cable at telescopic unit.



- 18** Disconnect teleflex nut at aft side of warning flag gear box.



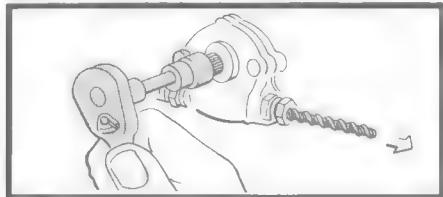
- 19** Pull disconnected teleflex conduit aft and free of cable.



- 20** Partially fill a clean, round five-gallon can (minimum inside diameter of 10 inches) with gas turbine lubricating oil (item 87, materials list). Place can below wing fold.

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- 21** Place wrench on warning flag gear box spline shaft nut and turn spline shaft driving teleflex cable out of the aft end of the gear box. Guide cable into can prepared in previous step and allow it to coil.



**Caution** Exercise care in removing and handling teleflex cable, as a roughened surface or a kinked cable requires replacement.

- 22** Allow teleflex cable to remain in can of gas turbine lubricating oil until installation.
- 23** Perform removal steps 9 through 15 and 17 through 22 for right-hand teleflex cable.

#### INSTALLING

- 1** Check airplane configuration making certain it is the same as at the time of removal procedure. Ensure that no gear box splines are engaged and conduit is free of dirt and dents.

- 2** Inspect cable for cleanliness.

- 3** Insert longest cable in left-hand warning flag gear box. Feed cable directly from lubricating oil can to keep it clean. Do not kink or roughen cable.

- 4** Bolthead index of cable lock on telescopic unit must be aligned with the fore and aft axis of the unit.

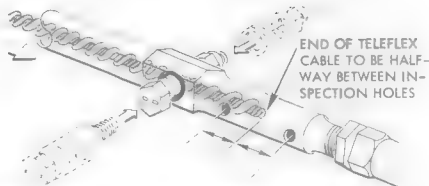


- 5** Place wrench on warning flag gear box spline shaft nut and turn spline shaft to drive teleflex into conduit.

- 6** Insert teleflex cable until it reaches a point midway between inspection holes on telescopic unit. Tighten cable lock.



FJ-48-2-12-23



- 7** Install small section of teleflex conduit at aft side of warning flag gear box.

**Note** All teleflex conduit nuts should be torqued from 30 to 65 inch-pounds.

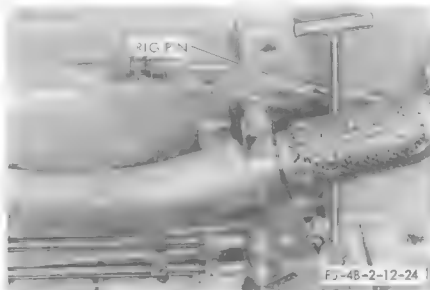


- 8** Place manual lockpin handle up.



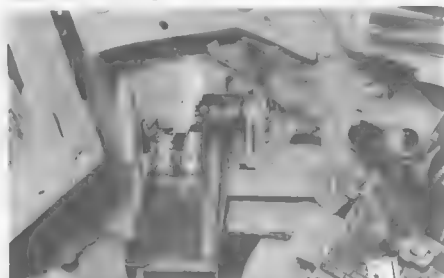
- 9** Insert rig pin in teleflex cable bell crank.

**Note** If rig pin cannot be installed or manual lockpin handle cannot be placed in the locked position, perform installing and rigging steps 10 through 16.



FJ-48-2-12-24

- 10** Remove fairing around manual lockpin handle.



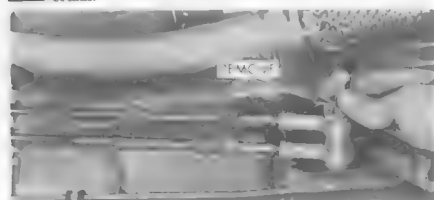
- 11** Adjust turnbuckle on rod connecting manual lockpin handle to bell crank until the handle will lock up.



- 12** Replace fairing.

- 13** See if rig pin can be installed; if not, unlock manual lockpin handle.

- 14** Remove bolt securing telescopic units to bell crank.



- 15** Lock manual lockpin handle and install rig pin.

- 16** Adjust attaching end of telescopic unit to align with bell crank bolt holes.

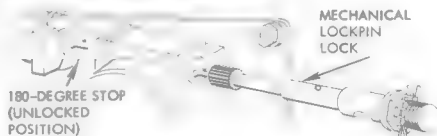


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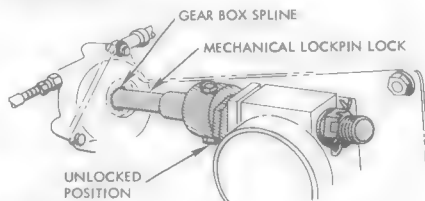
- 17** Remove rig pin, unlock manual lockpin handle and install bolt.



- 18** Insert mechanical lockpin lock through lockpin housing on left-hand wing and slip 180-degree stop over shaft of mechanical lock.



- 19** Engage gear box spline with mechanical lockpin lock. Ensure that lockpin lock is installed in the unlocked position.



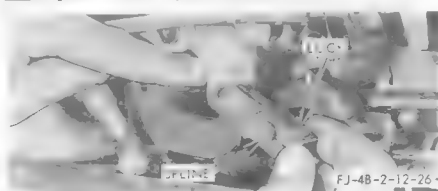
- 20** Install mechanical lockpin lock 180-degree stop.

**Caution** The 180-degree stop is installed against the housing in a clockwise position on the right-hand wing and a counterclockwise position on the left-hand wing.

- 21** Place manual lockpin handle to up position. The 180-degree stop should engage the lockpin housing stops in positions opposite to installation.

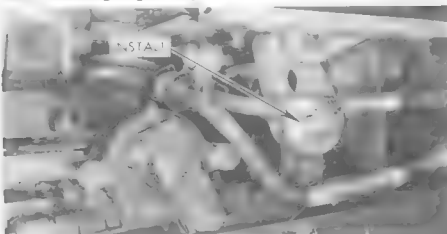
- 22** Remove nut and washer from left-hand warning flag gear box shaft.

- 23** Install actuator arm on warning flag gear box spline. Do not tighten locknut on arm.



FJ-4B-2-12-26

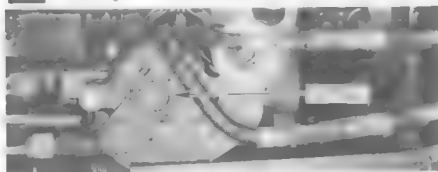
- 24** Install nut, bolt and washer securing arm to warning flag lever.



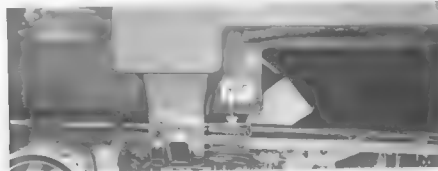
- 25** Tighten locknut enough to fully engage spline.



- 26** Install spline shaft nut and washer.



- 27** Place manual lockpin handle to the down position. Warning flag should extend approximately 75 degrees.



- 28** Carefully push aileron centering mechanism aft to engage gear box spline. Centering cam should fit snugly against aileron sector roller.



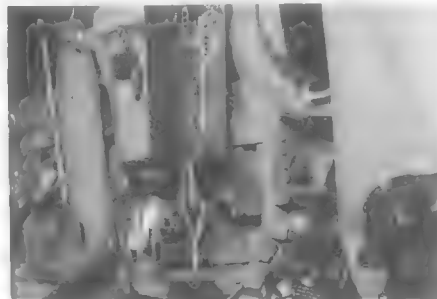
FJ-4B-2-12-27

*Note* If difficulty is encountered in installation step 28, refer to paragraph 3-85.)

- 29** Cycle manual lockpin handle several times.

- 30** Place handle in locked position and check flag position. Top of flag should be flush with wing skin. Adjust, if necessary, by relocating bolt in slot of flag link.

- 31** Using a spring scale, measure manual lockpin handle operating force in both directions. Force with only left-hand teleflex cable installed should not exceed 20 pounds in either direction.



- 32** Insert remaining cable in right-hand warning flag gear box. Feed cable directly from can. Do not kink or roughen it.

- 33** Perform installation steps 4 through 27 for right-hand teleflex cable.

- 34** Cycle manual lockpin handle several times.

- 35** While manual lockpin handle is locked, check that right-hand warning flag is flush with upper wing surface.

- 36** Using a spring scale, measure manual lockpin handle operating force in both directions. With both cables installed and rigged, force should not exceed 35 pounds in either direction.

- 37** Check physical security of entire installation.

- 38** Connect a 28-volt d-c external power source.

- 39** Connect hydraulic test stand to the utility system on the test connection panel. Adjust test stand for 5.5 gpm at 3000 psi.

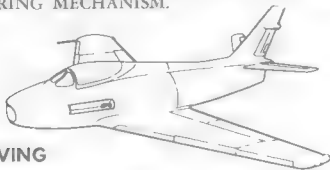
- 40** Place wing fold selector switch to "FOLD." This will retract lockpins.

- 41** Remove jury struts.

- 42** Check wing fold system. (Refer to paragraph 3-61.)

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3-85. REMOVING AND INSTALLING AILERON  
CENTERING MECHANISM.

## REMOVING

1

To center the control stick, proceed as follows:

- A. Connect an external power source to airplane.
- B. Connect hydraulic test stand to flight control system.
- C. Position emergency flight control system switch to "ON."
- D. Center control stick.
- E. Return emergency flight control switch to "OFF."

2

Place manual lock-pin handle to the down position.

3

Bleed gun pneumatic system air storage bottle. (Refer to paragraph 1-48.)

4

Remove cover around centering mechanism.

5

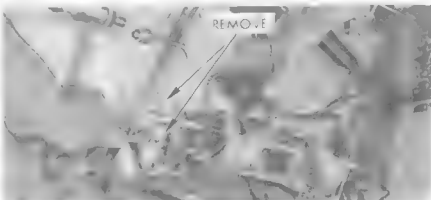
Disconnect air line forward of aileron centering mechanism to permit removal of centering mechanism mounting bracket.

6

Remove nut securing forward mounting bracket and shaft.

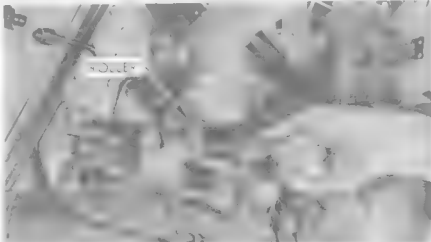
7

Remove bolts and nuts securing forward mounting bracket.



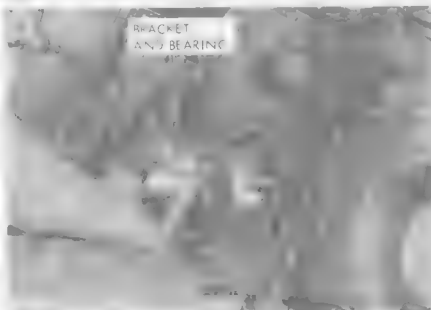
8

Remove bolt securing centering roller to aileron sector.



9

Rotate bracket counterclockwise and slide bracket and bearing forward free of shaft.



10

Carefully pull shaft and centering cam forward free of teleflex gear box spline.



FJ-48-2- 2-29

FJ-48-2-12-30

## INSTALLING

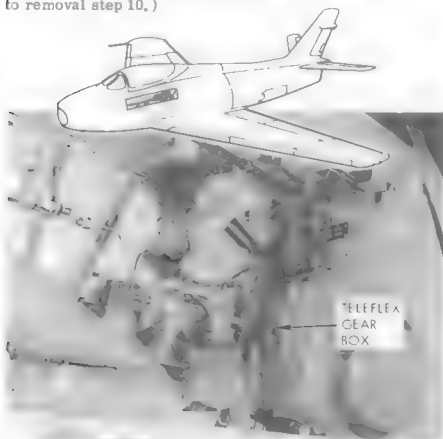
**1** Rig left-hand wing fold mechanical lock and warning flag. (Refer to paragraph 3-84.)

**2** Ensure that ailerons are still centered; if not, perform removal step 1.

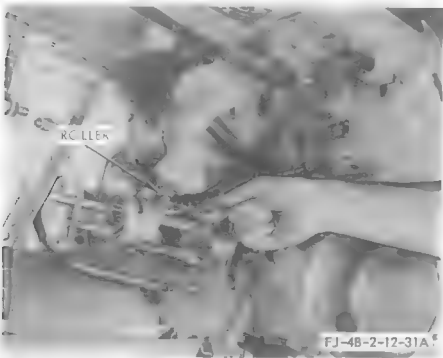
**3** Place wing fold manual lockpin handle to the down position.



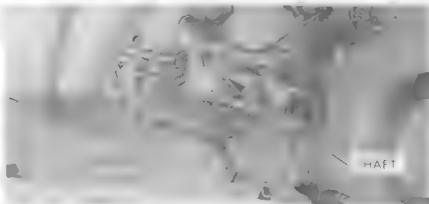
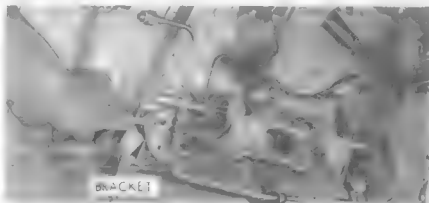
**4** Insert aileron centering cam shaft into teleflex gear box spline fitting with center of cam directly beneath center of aileron sector. (Refer to removal step 10.)



**5** Install aileron sector centering roller. (Refer to removal step 8.)



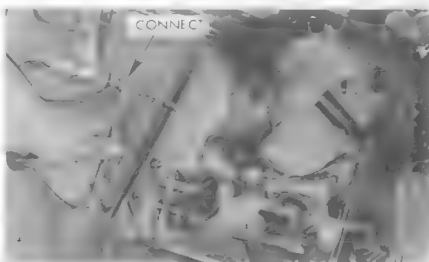
**6** Install aileron centering cam mounting bracket and secure shaft. (Refer to removal steps 6 and 7.)



**7** Adjust centering cam so it fits snugly against the aileron sector roller. Tighten locking bolts.



**8** Connect air line disconnected in removal step 5.



**9** Check physical security of installation.

**10** Install cover around centering mechanism.

**11** Charge gun pneumatic system air storage bottle. (Refer to paragraph 1-48.)

FJ-4B-2-12-32

**LANDING GEAR SYSTEM****3-86. LANDING GEAR SYSTEM.**

3-87. The airplane is equipped with a tricycle-type, retractable landing gear (figure 3-29). The main landing gear assemblies are knuckle-type gears and each assembly consists of a fixed post, a trailing link, an air-oil shock strut, a brake assembly and a wheel, tire and tube assembly. The nose landing gear assembly is a conventional-type gear consisting of an air-oil shock strut, a shimmy damper with a centering device and a wheel, tire and tube assembly. When the nose gear is retracting, the nose gear spindle rotates 90 degrees to position the wheel horizontal when fully retracted. The landing gear assemblies are actuated and locked hydraulically. When in the retracted position, the landing gears are completely faired within the airplane's outer surface. Each main landing gear assembly is faired by a wheel door, a strut door and a trunnion fairing. The wheel and strut doors are actuated and locked hydraulically. The trunnion fairing is attached to the gear by a bungee and follows the movement of the gears. The nose gear is faired by a wheel door and strut fairing. The wheel door is actuated and locked hydraulically. The strut door is rigidly attached to the strut and follows the movement of the gear. Both the landing gears and fairing doors receive hydraulic pressure for operation from the utility hydraulic power system. Hydraulic pressure to the landing gear system is controlled by a multiple-type, solenoid-operated selector valve and a system of electrical sequence switches. The sequence switches co-ordinate gear and door movement after the gear-up or gear-down selection is made. A position indicating and warning system, integrated with the sequencing system, provides visual indication of landing gear position. An emergency extension system provides a mechanical means of extending the main landing gears and a "one shot" emergency hydraulic system provides a means for extending the nose gear in the event of a hydraulic or electrical failure. A ground safety switch is installed on the left main landing gear trailing link to prevent the landing gears from being retracted while the weight of the airplane is on them. A tail bumper, installed on the lower centerline of the aft fuselage structure, prevents structural damage should the aft section hit during take-off or landing.

**3-88. FUNCTION OF LANDING GEAR SYSTEM—CONTROL HANDLE "UP," GEAR DOWN, DOORS OPENING.**

3-89. When the weight of the airplane is off the landing gear, the ground safety switch is actuated to the closed position and completes a ground to energize ground safety relay No. 1 which provides a holding circuit for the landing gear retract control relay (L.G. RETRACT CONTROL) (figure 3-30). When the landing gear control handle is placed to the "up" position, the landing gear control switch is actuated and electrical

power is routed through the landing gear retract control relay (L.G. RETRACT CONTROL) and the nose gear uplock switch to energize the door-open solenoid on the six-way gear and door control valve. When the door-open solenoid is energized, a sliding spool is positioned within the valve to direct utility hydraulic system pressure to unlock and actuate the hydraulically operated doors to the open position. The red light in the control handle illuminates when the control handle is placed in the "up" position. The sequence of operation is as follows:

- a. Airplane's weight is off landing gears and ground safety switch is unloaded.
- b. Ground safety relay No. 1 is energized and the holding circuit to the landing gear retract control relay (L.G. RETRACT CONTROL) is completed.
- c. Landing gear control handle is in "up" position.
- d. Red light in control handle illuminates.
- e. Electrical power is routed through the landing gear retract control relay (L.G. RETRACT CONTROL) and the nose gear uplock switch to energize the door-open solenoid on the six-way gear and door control valve.
- f. Hydraulic pressure is directed to unlock and open the hydraulically operated fairing doors.

**3-90. FUNCTION OF LANDING GEAR SYSTEM—CONTROL HANDLE "UP," DOORS OPEN, GEAR RETRACTING.**

3-91. When the hydraulically actuated doors near the full open position, each door mechanically actuates a door-open sequence switch. All of these switches are connected in series. When all five door-open sequence switches have been actuated, a circuit is completed to energize the gear-up solenoid on the six-way gear and door control valve (figure 3-31). When the gear-up solenoid is energized, a sliding spool is positioned within the valve to direct utility system hydraulic pressure to unlock the landing gear downlocks and to actuate the landing gears to the retracted position. When the downlock pins are pulled from the locked position, the downlock switches are actuated to the open position, permitting the position indicators in the cockpit to return to the intermediate position and indicate an unsafe condition. The main gear trunnion fairings and nose gear strut fairing are closed by the movement of their respective gears. As the nose gear retracts, the nose gear wheel is rotated to a horizontal position as it enters the nose wheel well. This is accomplished by the shimmy damper torque arm engaging a cam on the fuselage structure and rotating the nose gear spindle 90 degrees in the spindle housing. When the landing gear nears the retracted position, the uplock roller on the landing gear post cams open the uplock hook and when the landing gear reaches the fully retracted position, bungee action closes the uplock hook, locking the landing gear in the retracted

Section III  
Landing Gear System

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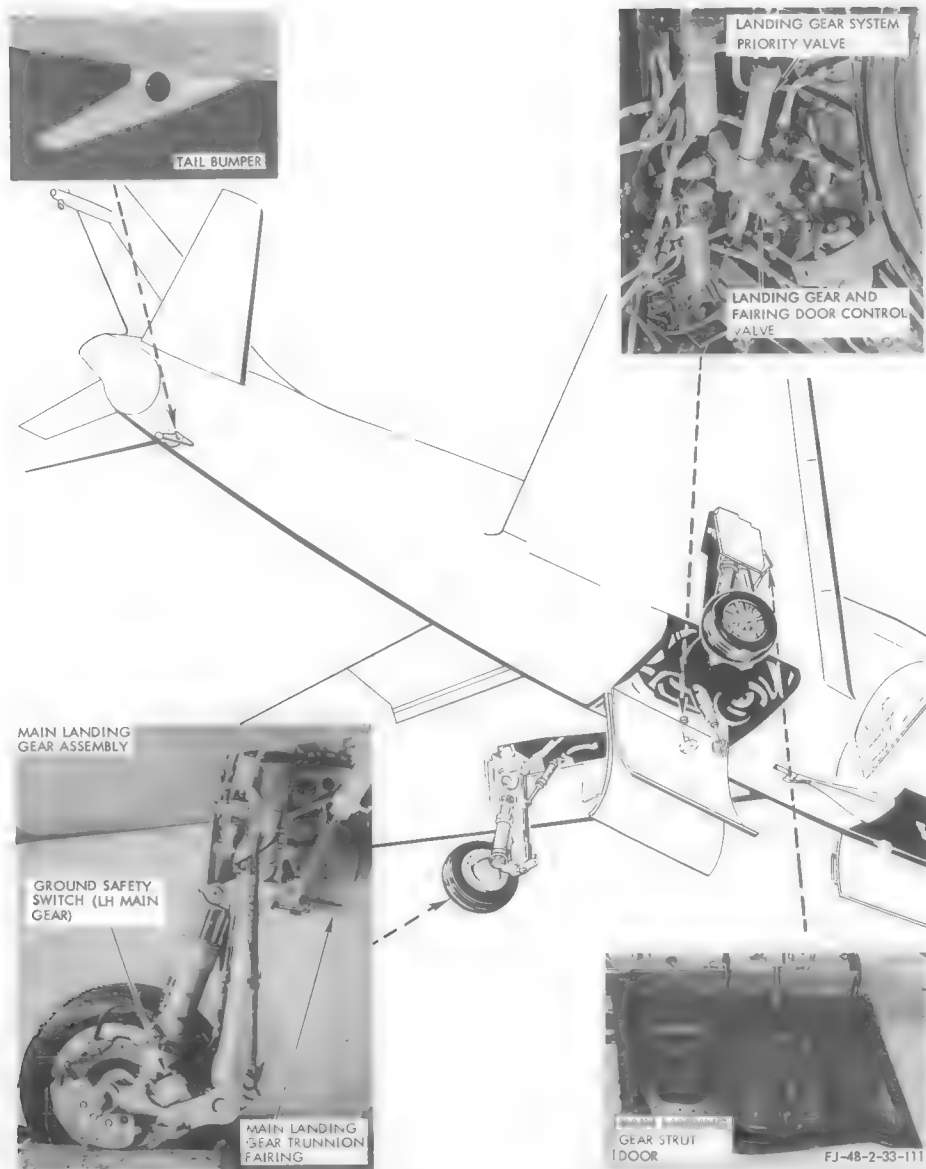
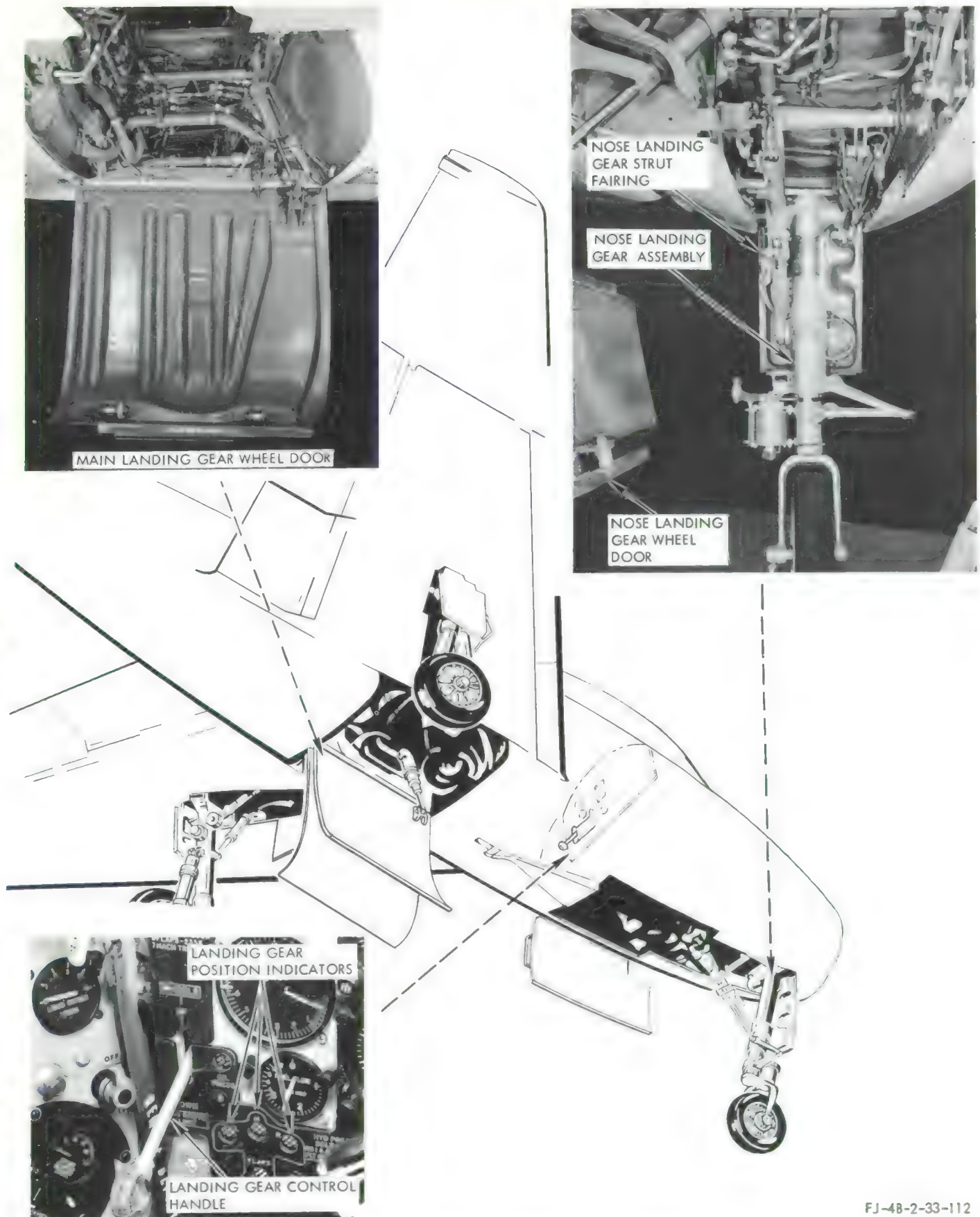


Figure No. 3-29. Landing Gear System Unit Location (Sheet 1)



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Figure No. 3-29. Landing Gear System Unit Location (Sheet 2)



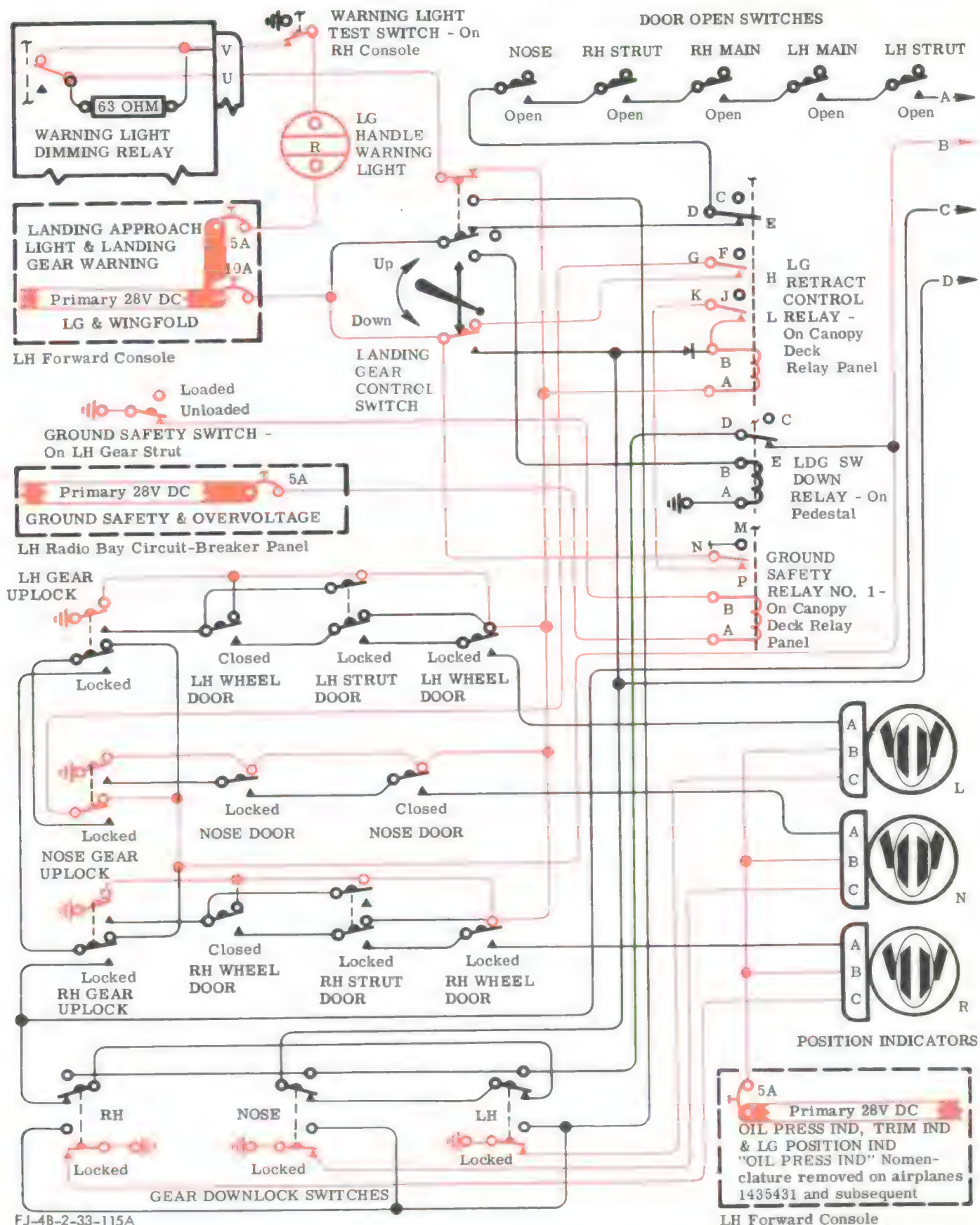
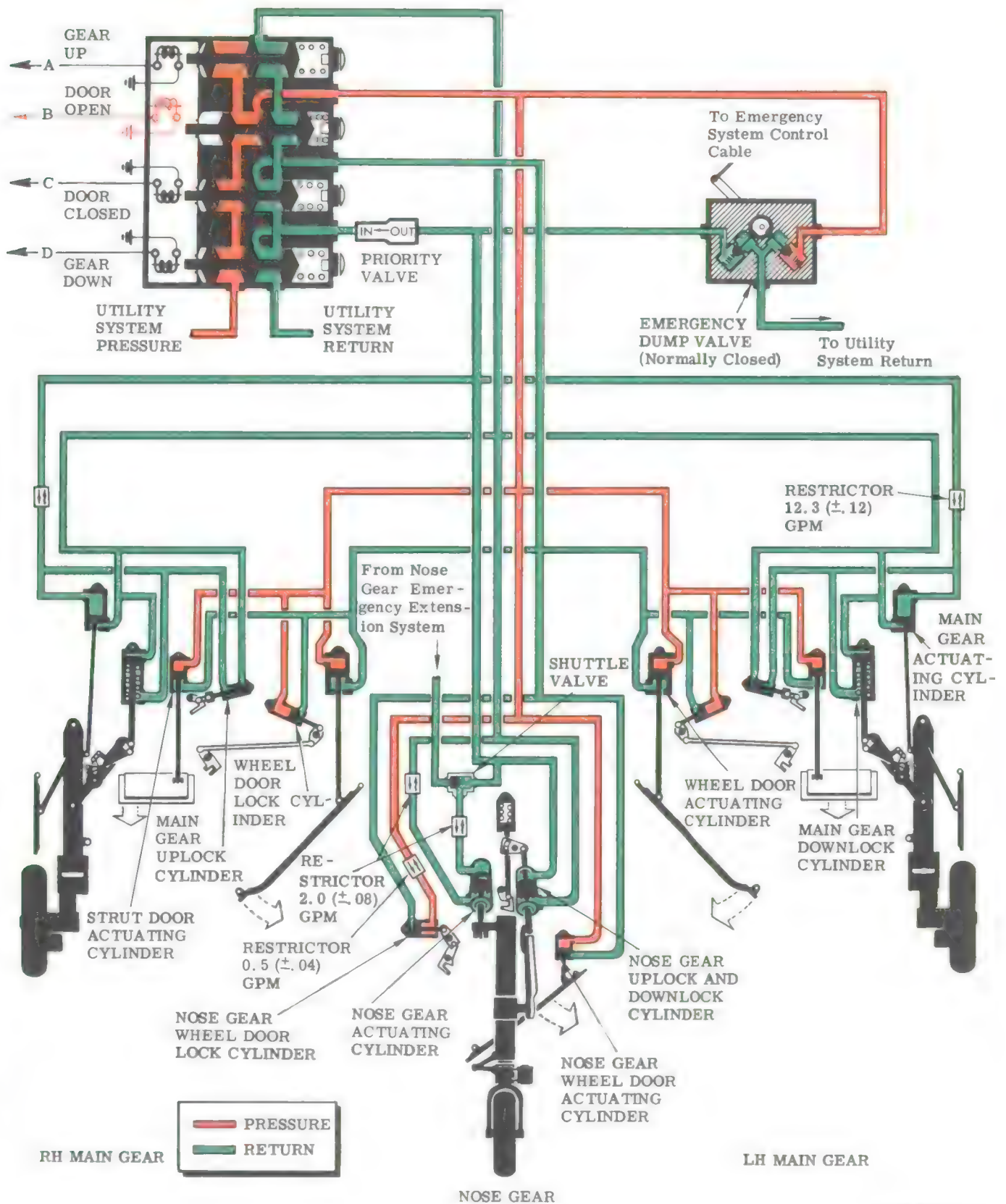


Figure No. 3-30. Landing Gear System—Control Handle "UP," Gear Down, Doors Opening (Sheet 1)



FJ-4B-2-33-87

Figure No. 3-30. Landing Gear System—Control Handle "UP," Gear Down, Doors Opening (Sheet 2)



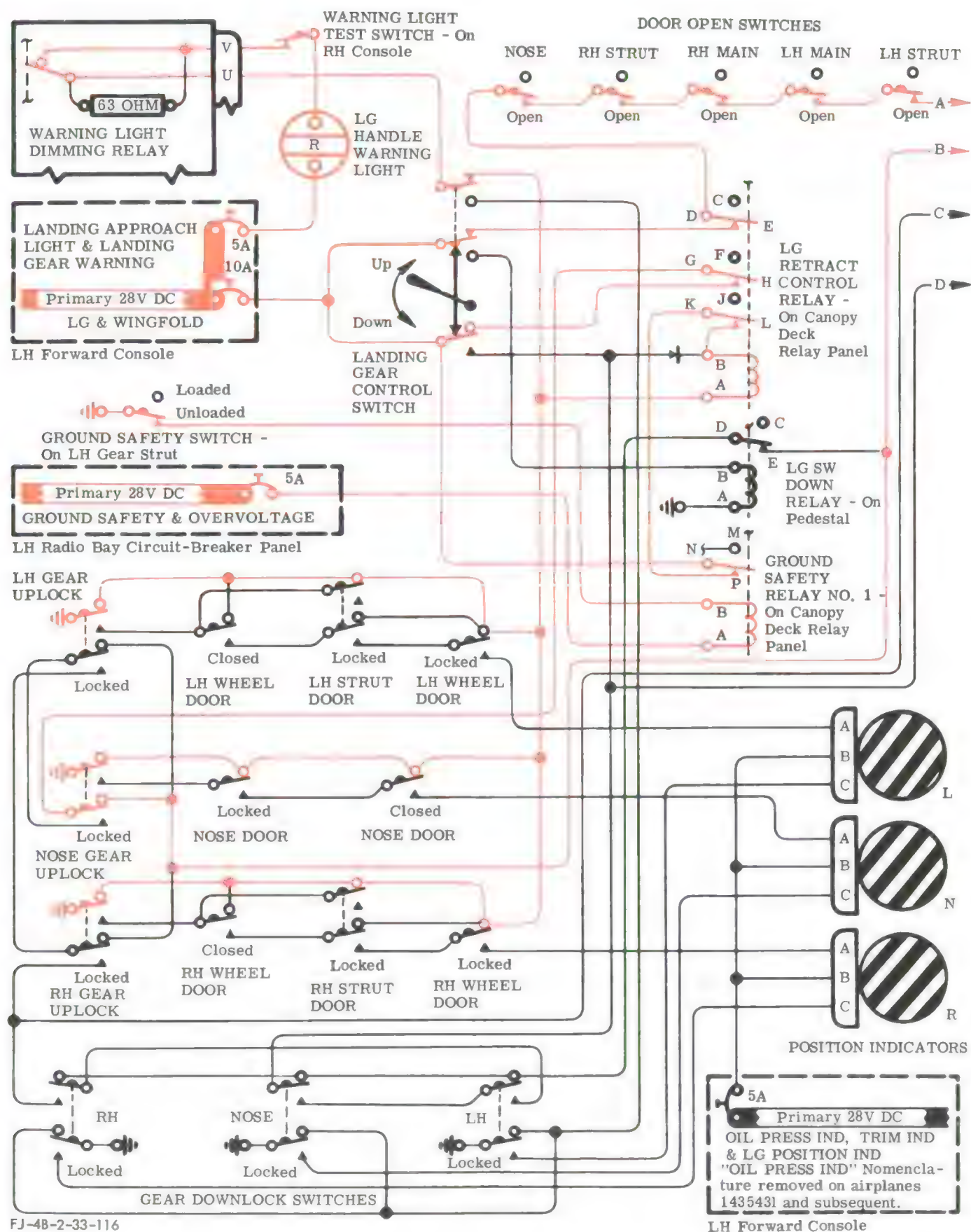
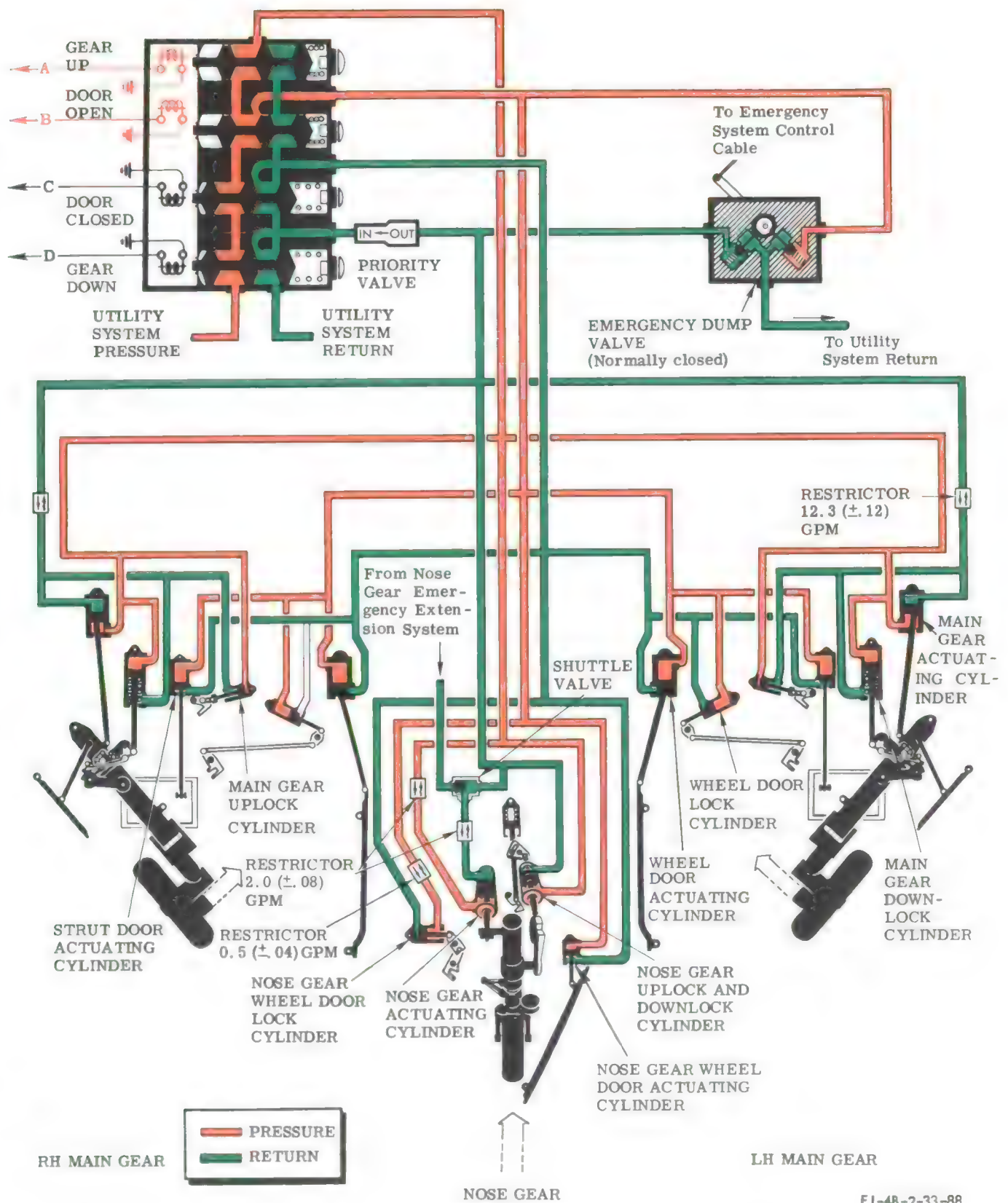


Figure No. 3-31. Landing Gear System—Control Handle "UP," Doors Open, Gear Retracting (Sheet 1)





FJ-4B-2-33-88

Figure No. 3-31. Landing Gear System—Control Handle "UP," Doors Open, Gear Retracting (Sheet 2)

position. As each uplock hook closes, it actuates the uplock switch to the closed position. The sequence of operation is as follows:

- a. All hydraulically operated fairing door-open switches are actuated and a circuit to the gear-up solenoid on the six-way gear and door control valve is completed.
- b. Hydraulic pressure is directed to the unlock side of the downlock cylinders and to the up side of the gear actuating cylinders.
- c. The downlock cylinder retracts the lockpin and pulls the side brace from an overcenter condition.
- d. Gear position indicator in the cockpit shows an unsafe condition.
- e. The gear actuating cylinder retracts the gear to the up and locked position.
- f. Nose gear wheel is rotated 90 degrees while being retracted.
- g. Gear uplock switches are actuated to the closed position.

3-92. FUNCTION OF LANDING GEAR  
SYSTEM—CONTROL HANDLE  
"UP," GEAR UP, DOORS CLOSING.

3-93. When the three landing gear uplock switches have been actuated to the closed position, an electrical circuit is completed to energize the door-closed solenoid on the six-way gear and door control valve (figure 3-32). When the door-closed solenoid is energized, a sliding spool is positioned within the valve to direct utility hydraulic system pressure to actuate and lock the doors in the closed position. When the hydraulically actuated door starts moving toward the closed position, the first door-open sequence switch that is actuated breaks the circuit to the gear-up solenoid and that portion of the landing gear system is depressurized. The sequence of operation is as follows:

- a. Circuit to the door-closed solenoid on the six-way gear and door control valve is completed through the landing gear uplock switches.
- b. Hydraulic pressure is directed to start closing the hydraulically operated doors.
- c. Door-open sequence switches are actuated to the open position, breaking the circuit to the gear-up solenoid and depressurizing that portion of the landing gear system.

3-94. FUNCTION OF LANDING GEAR  
SYSTEM—CONTROL HANDLE  
"UP," GEAR UP, DOORS CLOSED.

3-95. When the nose and main gear hydraulically operated wheel doors near the closed position, a lock roller, on the forward edge of the door, engages the lock hook and trips the locking mechanism overcenter, permitting the wheel door lock cylinders to lock the doors in the closed position (figure 3-33). When each wheel door closes and locks, the door closed and locked switches are actuated to the closed positions. When the main gear

strut door nears the closed position, its hook engages a roller on the wheel well structure and trips the locking mechanism overcenter to permit the strut door actuating cylinder to lock the strut door in the closed position. When the strut door locks, the strut door lock switch is actuated to the closed position. When all hydraulically operated doors are closed and locked with the gear up and locked, a circuit is completed to the respective position indicator in the cockpit and the word "UP" will appear in the indicator dial. At the same time, the ground for the warning light and the landing gear retract control relay (L.G. RETRACT CONTROL) is broken. When the landing gear retract control relay (L.G. RETRACT CONTROL) is de-energized, the circuit is broken to the gear and door control valve, de-energizing the door-closed solenoid. With the landing gear up and locked and the doors closed and locked, the word "UP" appears in each indicator dial, the red warning light is out and the landing gear system is open to return and is completely depressurized. The sequence of operation is as follows:

- a. The hydraulically operated doors are actuated to the closed and locked position.
- b. The door closed and locked switches are actuated to the closed position and the position indicators in the cockpit show the word "UP" to indicate a safe gear condition.
- c. The red warning light goes out.
- d. The landing gear retract control relay (L.G. RETRACT CONTROL) is de-energized.
- e. The landing gear system is completely depressurized.

3-96. FUNCTION OF LANDING GEAR SYSTEM —  
CONTROL HANDLE "DOWN," DOORS  
OPENING, GEAR EXTENDING.

3-97. When the landing gear control handle is placed in the "DOWN" position, the landing gear control switch is actuated and electrical power is routed directly to energize the landing gear retract control relay (L.G. RETRACT CONTROL) and the gear-down solenoid (figure 3-34). The control switch simultaneously routes electrical power to energize the landing gear switch down relay (LD GR SW DOWN), thus completing a circuit to the door-open solenoid through the nose landing gear downlock switch. When the gear-down and door-open solenoids are energized, the sliding spools within the control valve are positioned to direct utility hydraulic system pressure to unlock and actuate the hydraulically operated doors open and to unlock, actuate and lock down the landing gears. However, a priority valve installed in the gear-down line permits a sufficient amount of hydraulic pressure to unlock and completely open the doors, prior to unlocking and extending the landing gears. This prevents the landing gears from riding the doors open. When hydraulic pressure is routed to unlock and actuate the hydraulically operated doors, initial movement of the strut door actuating cylinder breaks the locking mechanism from its overcenter condition and opens the doors. The wheel door unlocking cylinders



overcome the lock bungee and move the locking mechanism from its overcenter condition; thus the wheel door actuating cylinders are free to open the doors. When the hydraulically operated doors are unlocked and opened, the door closed and locked switches are actuated to the open position, breaking the ground to the position indicators; each dial shows a barber pole effect, indicating an unsafe gear condition. When the hydraulically operated doors reach the full open position, increasing hydraulic pressure in the landing gear down lines unseats the priority valve and pressure is directed to unlock and extend the landing gears. The uplock cylinder unlocks the gear by overcoming the force of the uplock bungee and pulling the hook away from the roller. When the uplock hooks are pulled away from the roller, the uplock switches are actuated to the open position. The sequence of operation is as follows:

- a. Landing gear control handle is in "DOWN" position.
- b. Red warning light illuminates.
- c. Electrical power is routed through the control switch to energize the landing gear retract control relay (L.G. RETRACT CONTROL), the gear-down solenoid, the landing gear switch down relay (LD GR SW DOWN) and the door-open solenoid.
- d. The priority valve momentarily directs hydraulic pressure to unlock and fully open the hydraulically actuated doors.
- e. Door closed and locked switches are actuated to the open position and the position indicators in the cockpit show a barber pole effect to indicate an unsafe gear condition.
- f. Hydraulic pressure in the gear-down line unseats the priority valve and unlocks the landing gear uplocks.
- g. Landing gear uplock switches are actuated to the open position.

### 3-98. FUNCTION OF LANDING GEAR SYSTEM — CONTROL HANDLE "DOWN," GEAR DOWN, DOORS CLOSING.

3-99. When the landing gears near the down position, the side braces are forced overcenter and the spring-loaded downlock pins are free to engage and lock the gear in the down position. As each downlock pin engages, it actuates the downlock switch to the closed position. When each downlock switch closes, a circuit is completed to the respective position indicator and a tire

appears in that indicator dial, indicating that the gear is down and locked. When all downlock switches are closed, the ground to the warning circuit is broken and the red light will go out (figure 3-35). At the same time, the door-open solenoid is de-energized and a circuit is completed to energize the door-closed solenoid on the gear and door control valve. When the door-closed solenoid is energized, a sliding spool is positioned within the valve to direct utility system hydraulic pressure to close and lock the door. The sequence of operation is as follows:

- a. The spring-loaded downlock roller forces the side brace overcenter and the spring-loaded downlock pin locks the gear in the down position.
- b. The landing gear downlock switches are actuated to the closed position.
- c. The position indicators in the cockpit show a tire tread, indicating a safe gear condition.
- d. The red warning light goes out.
- e. The circuit is completed to energize the door-closed solenoid.
- f. The hydraulically operated doors close and lock.

### 3-100. FUNCTION OF LANDING GEAR SYSTEM—CONTROL HANDLE "DOWN," GEAR DOWN, DOORS CLOSED, WEIGHT OF AIRPLANE ON GEAR.

3-101. With the weight of the airplane on the landing gear, the ground safety switch is actuated to the open position (figure 3-36). When the ground safety switch is opened, the circuit for ground safety relay No. 1 is broken and the relay is de-energized. This, in turn, opens the holding circuit to the landing gear retract control relay (L.G. RETRACT CONTROL) and prevents the landing gear from being retracted with the weight of the airplane on the gear. With hydraulic and electrical power present, the control handle in "DOWN" position, the landing gear down and locked and the fairing doors closed and locked, the landing gear system remains pressurized. The sequence of operation is as follows:

- a. Ground safety switch is actuated to the open position.
- b. Ground safety relay No. 1 is de-energized.
- c. Holding circuit to landing gear retract control relay (L.G. RETRACT CONTROL) is broken.
- d. Landing gear system remains pressurized.

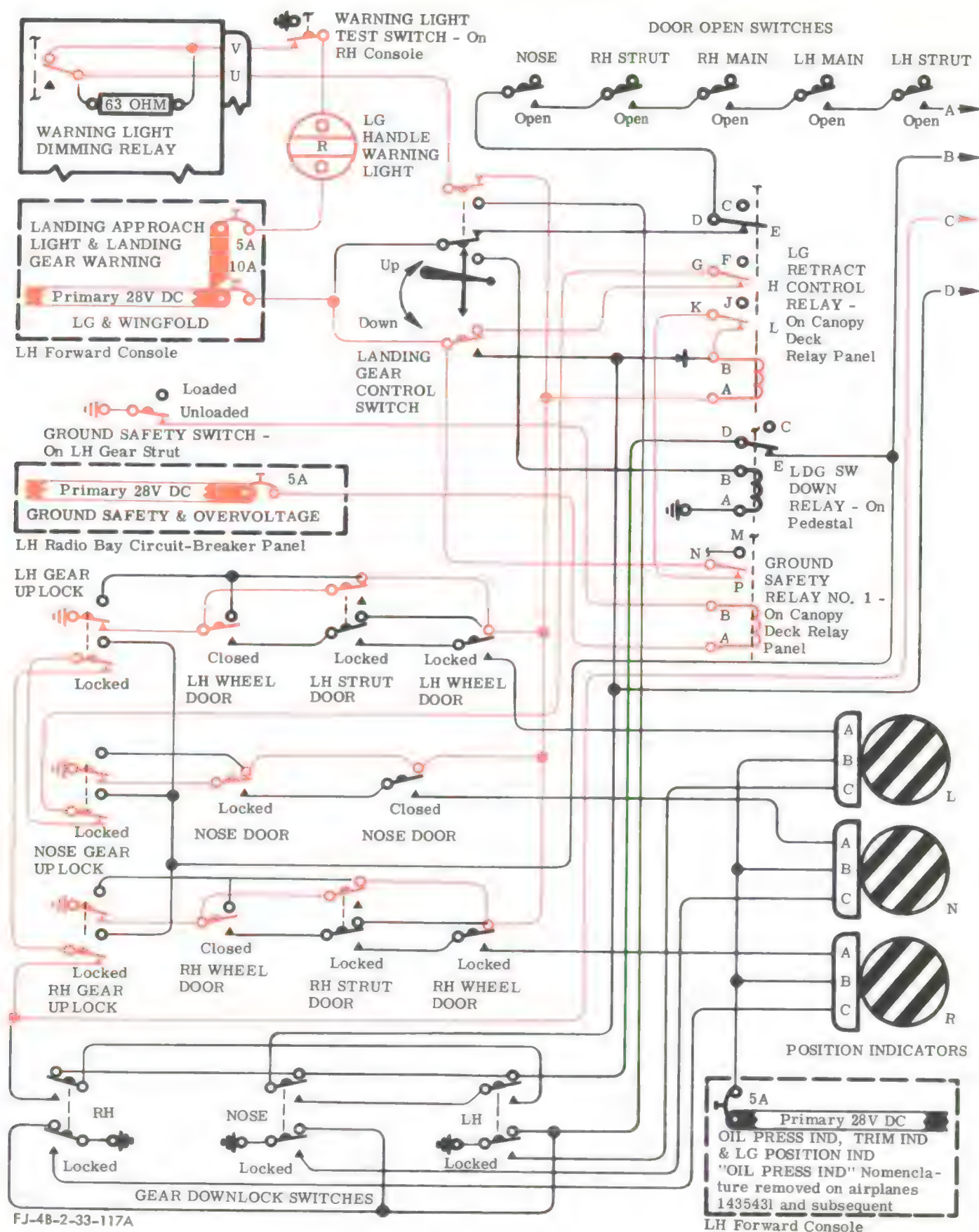
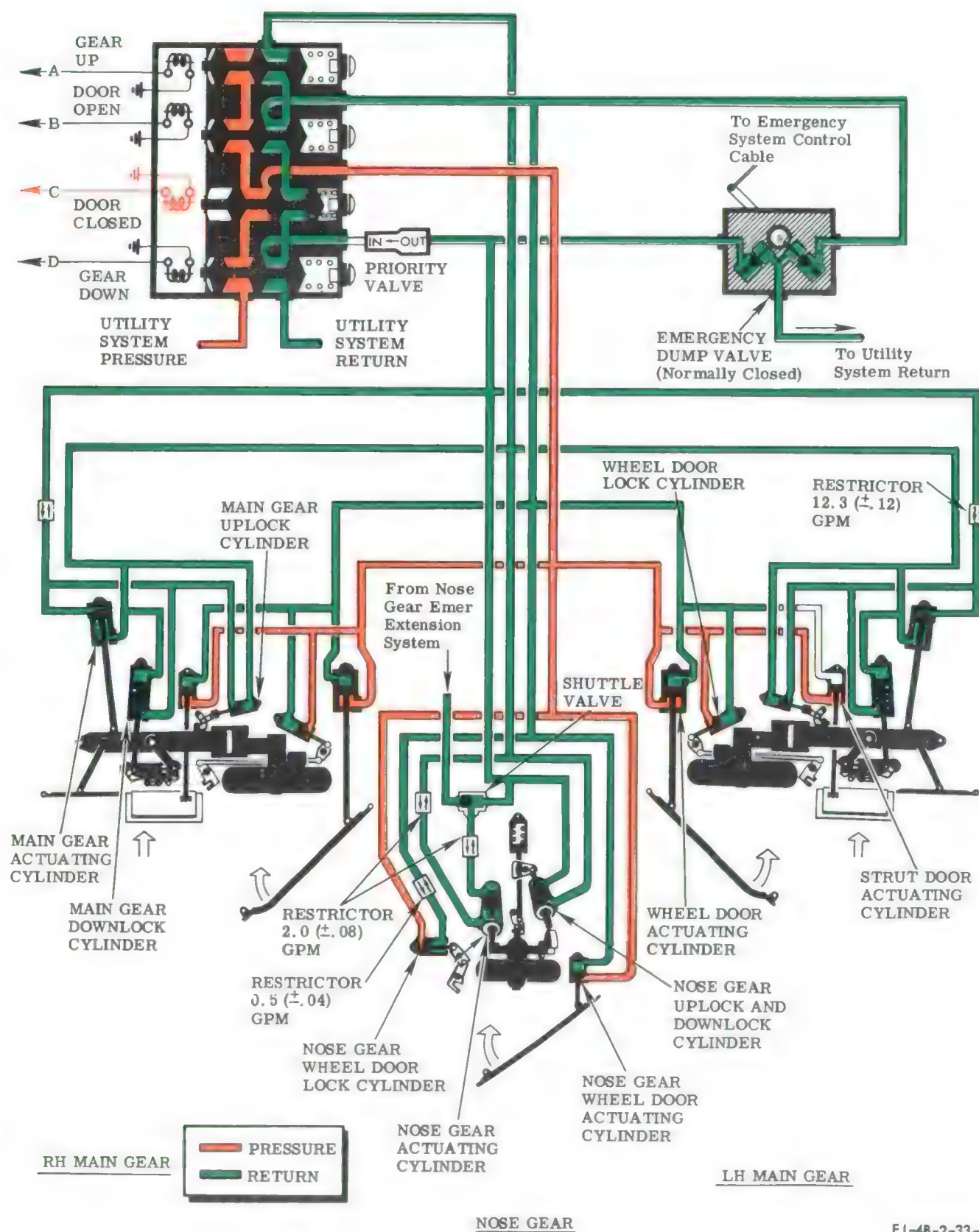


Figure No. 3-32. Landing Gear System—Control Handle "UP," Gear Up, Doors Closing (Sheet 1)





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Figure No. 3-32. Landing Gear System—Control Handle "UP," Gear Up, Doors Closing (Sheet 2)

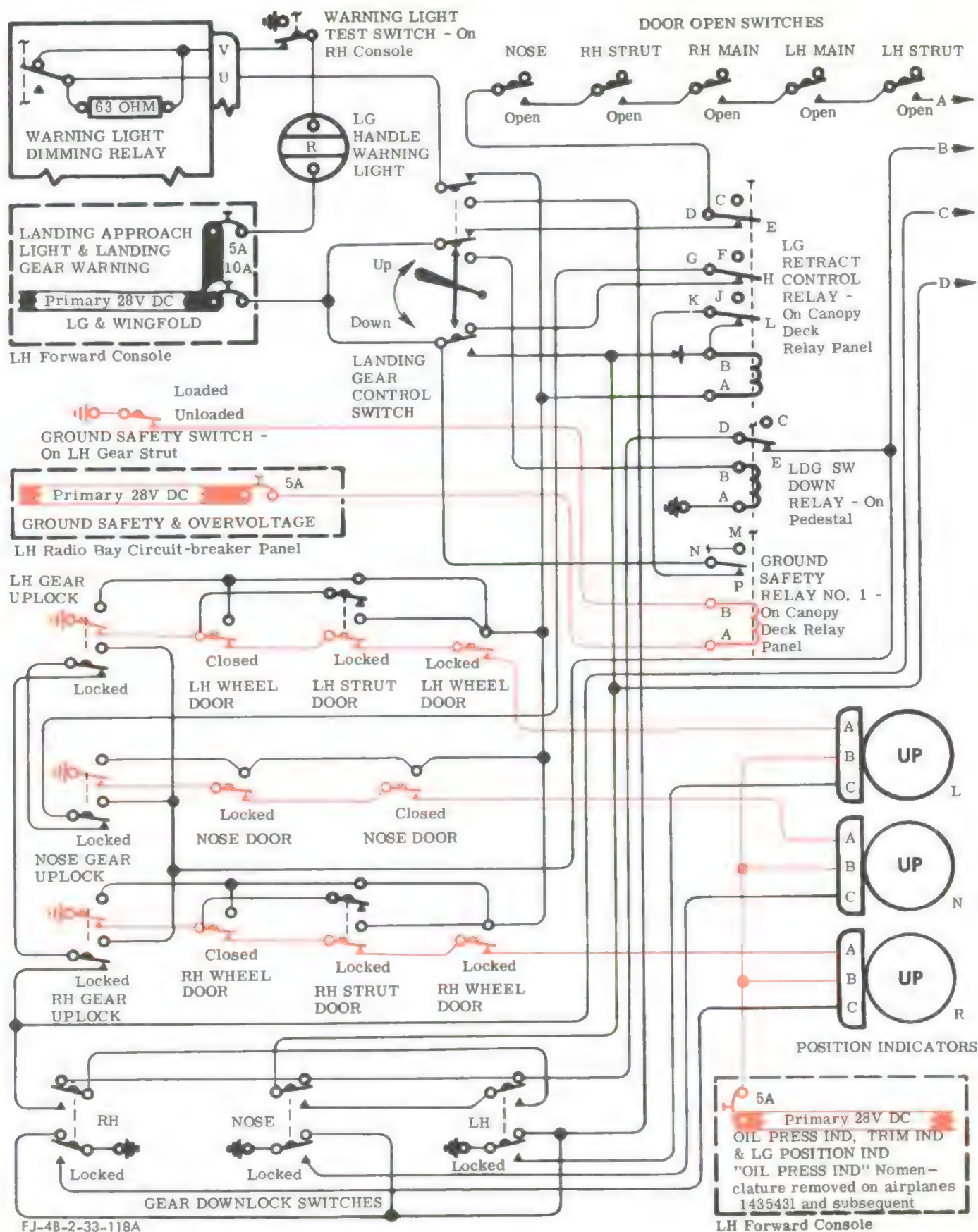
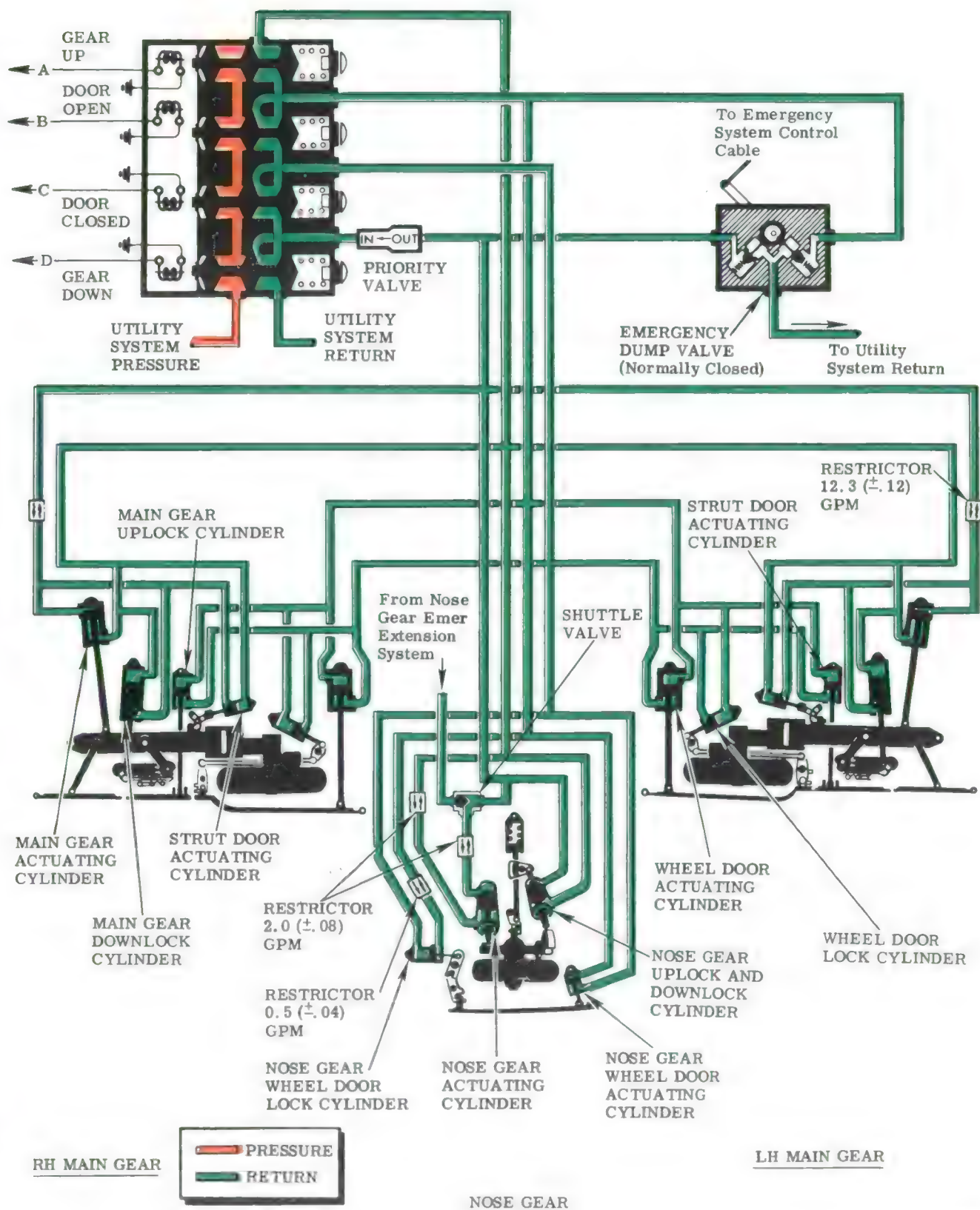


Figure No. 3-33. Landing Gear System—Control Handle "UP," Gear Up, Doors Closed (Sheet 1)





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Figure No. 3-33. Landing Gear System—Control Handle "UP," Gear Up, Doors Closed (Sheet 2)

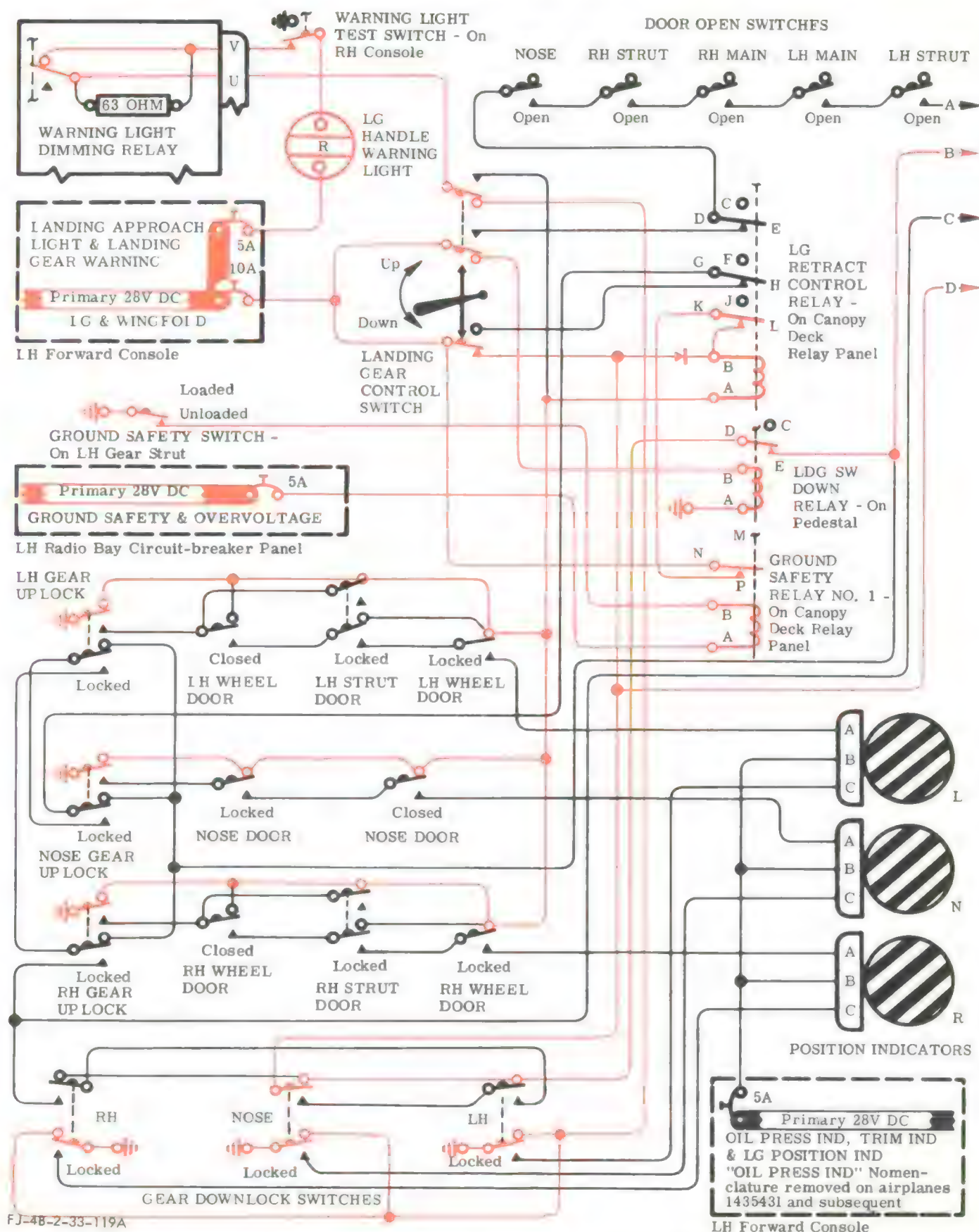
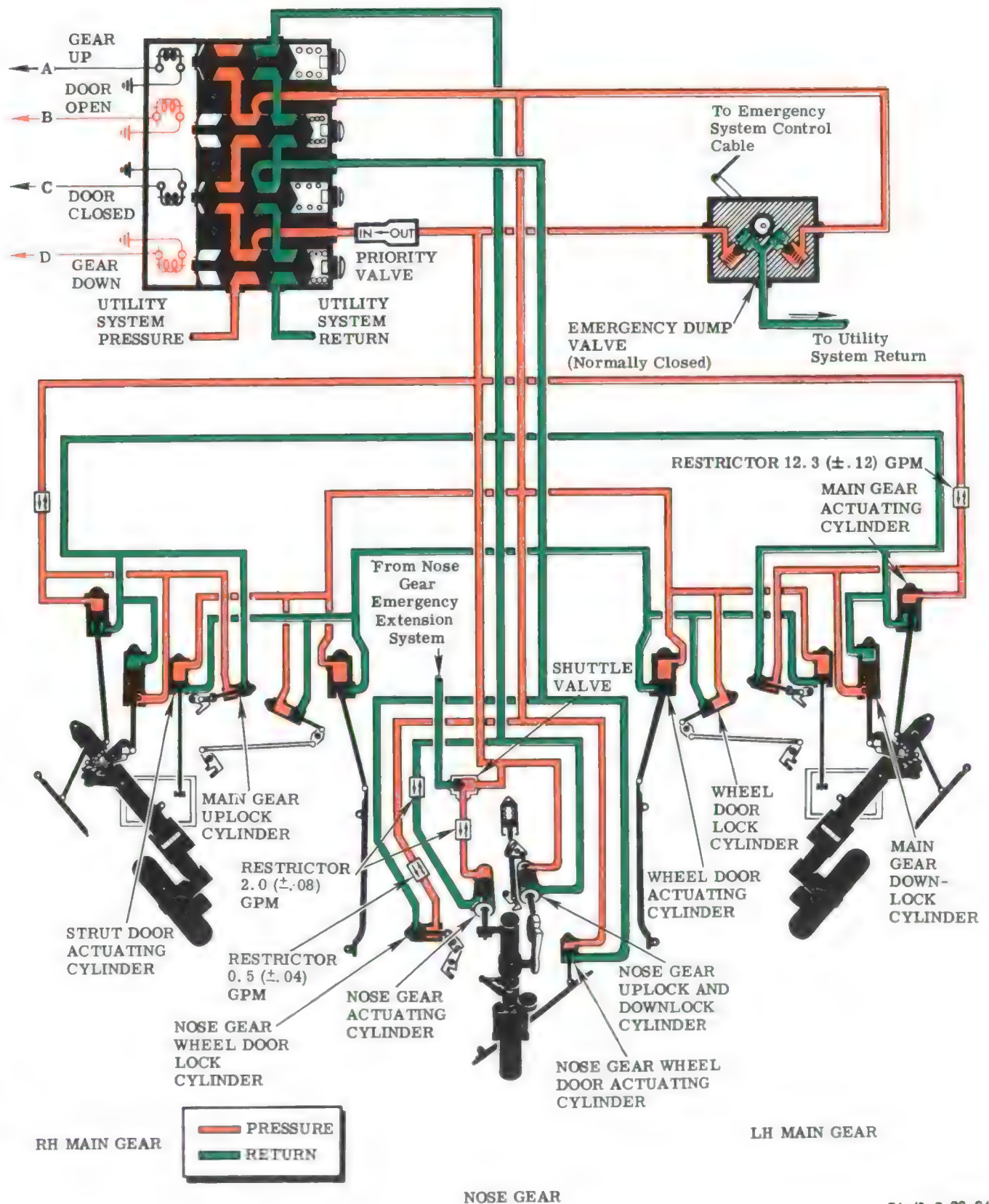


Figure No. 3-34. Landing Gear System—Control Handle "DOWN," Doors Opening, Gear Extending (Sheet 1)





FJ-48-2-33-84

Figure No. 3-34. Landing Gear System—Control Handle "DOWN," Doors Opening, Gear Extending (Sheet 2)

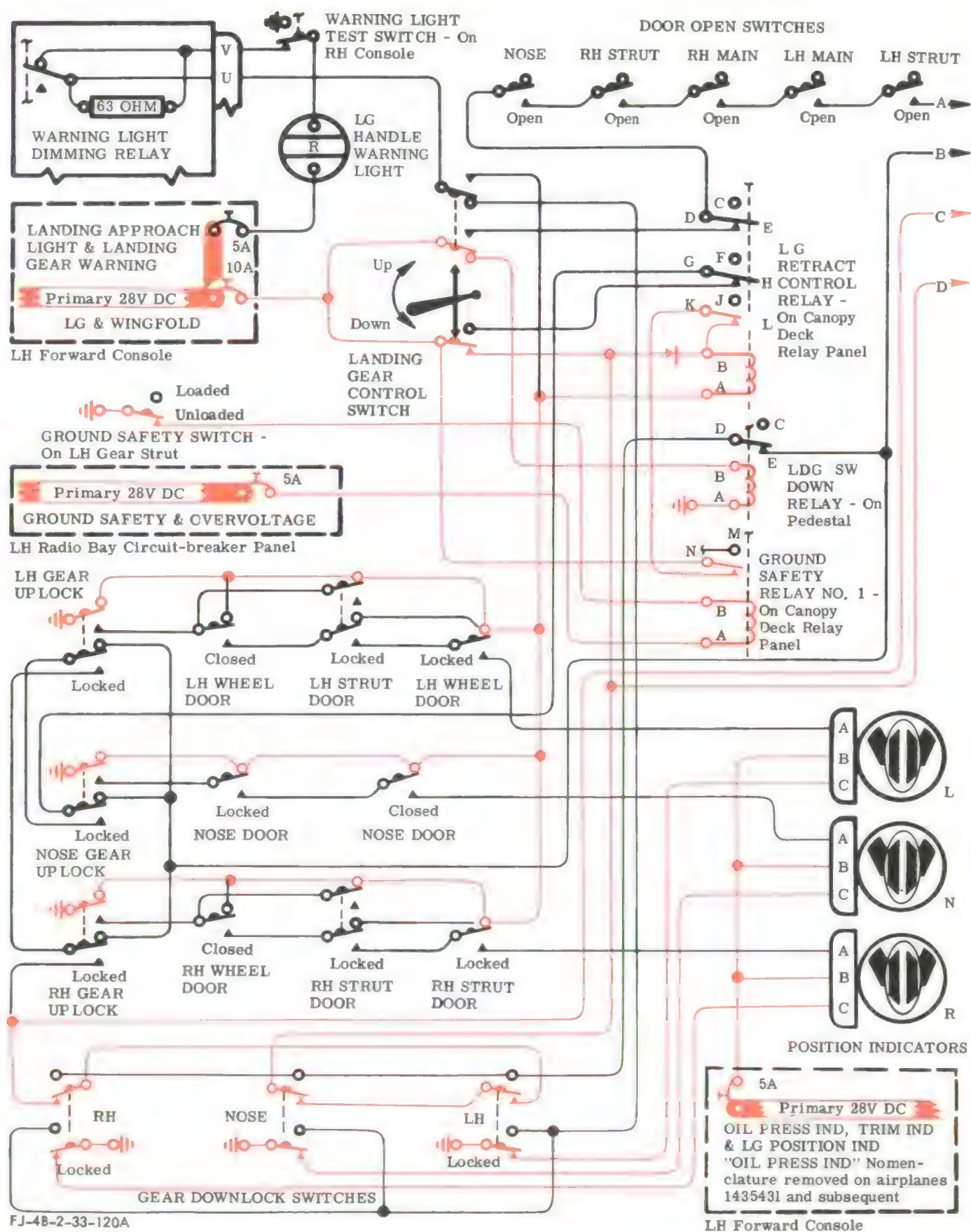
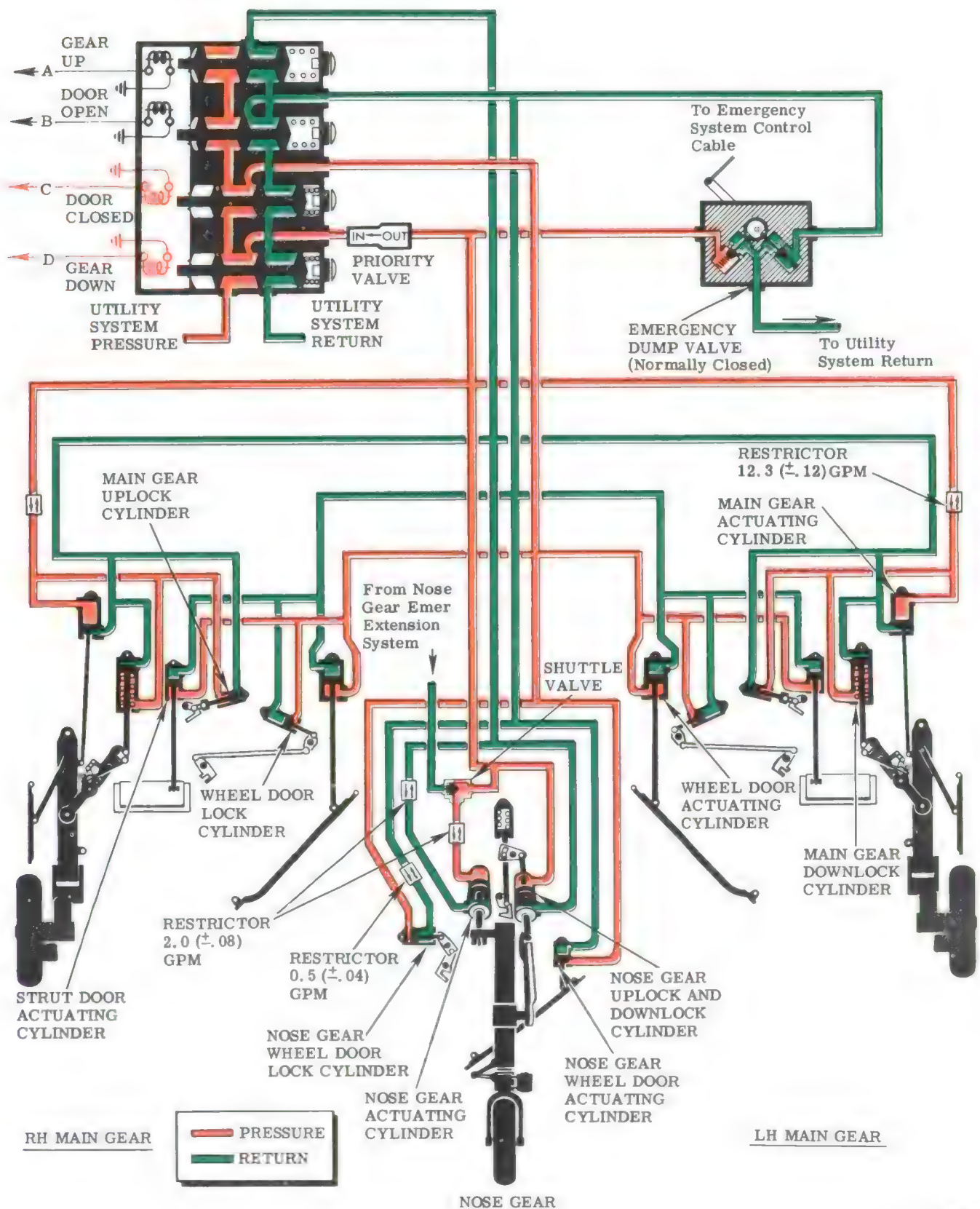


Figure No. 3-35. Landing Gear System—Control Handle "DOWN," Gear Down, Doors Closing (Sheet 1)





FJ-4B-2-33-85

Figure No. 3-35. Landing Gear System—Control Handle "DOWN," Gear Down, Doors Closing (Sheet 2)

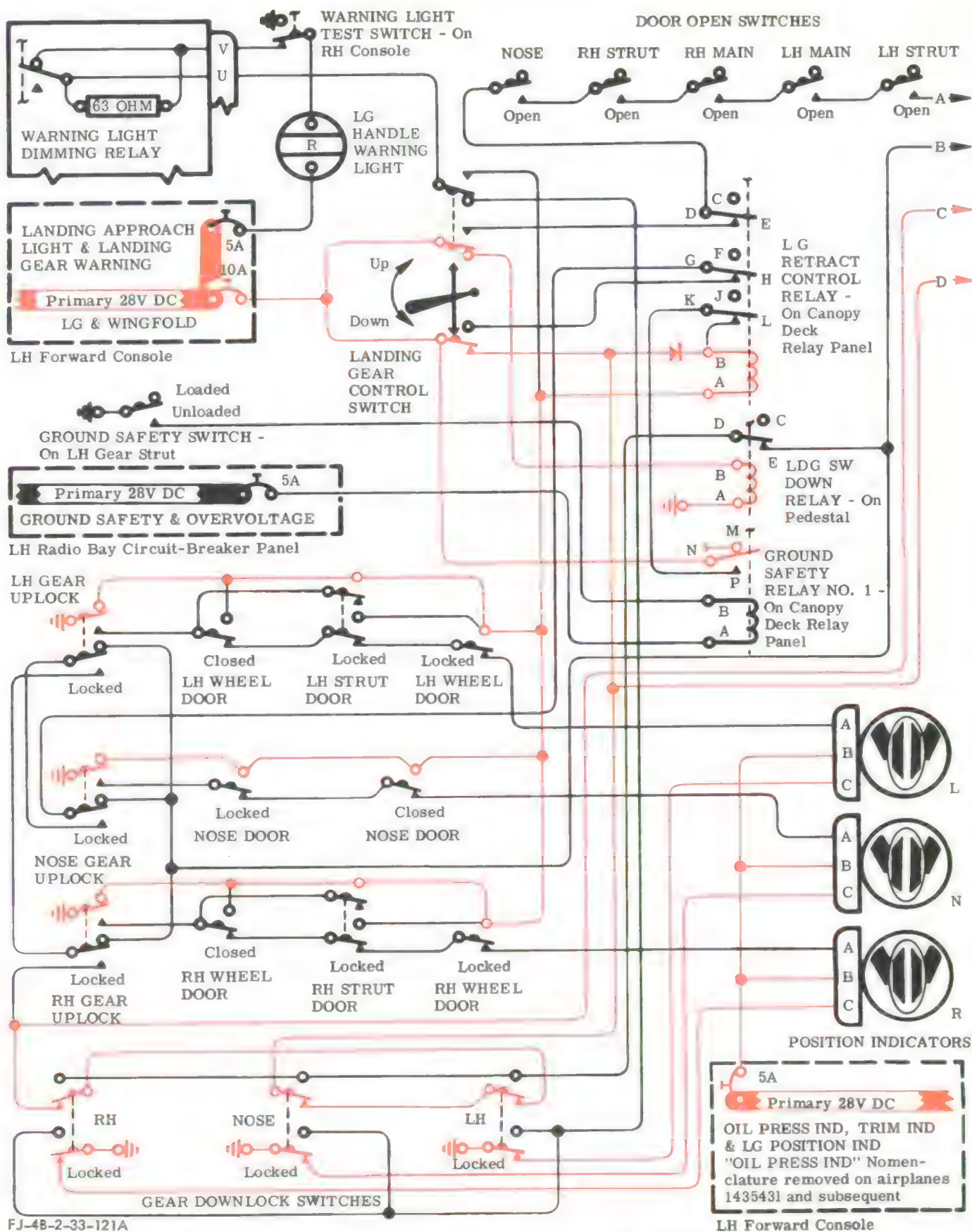
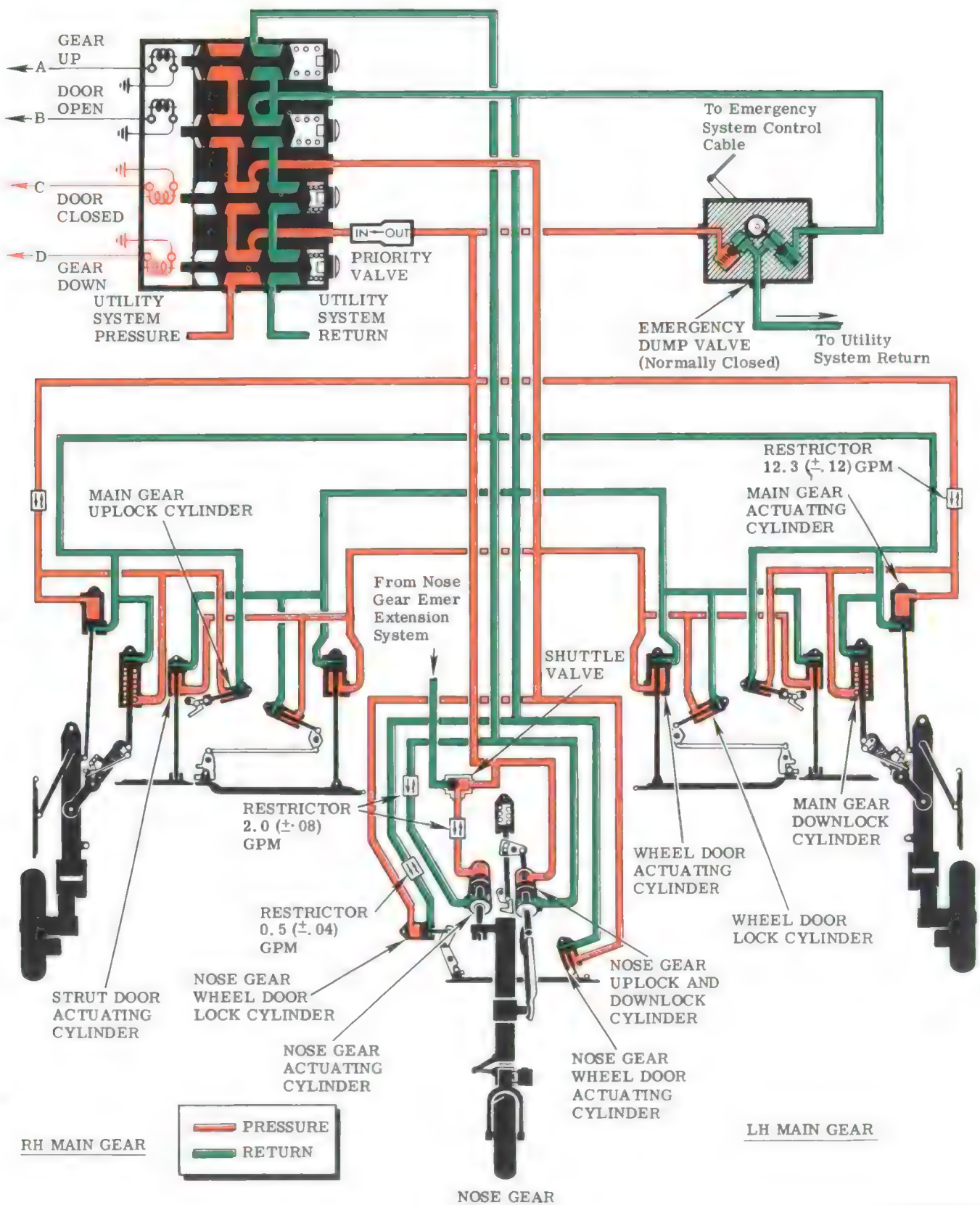


Figure No. 3-36. Landing Gear System—Control Handle "DOWN," Gear Down, Doors Closed, Weight of Airplane on Gear (Sheet 1)





FJ-4B-2-33-86

Figure No. 3-36. Landing Gear System—Control Handle "DOWN," Gear Down, Doors Closed, Weight of Airplane on Gear (Sheet 2)

Section III  
Landing Gear System

NAVAER 01-60JKE-502

3-102. TROUBLE SHOOTING LANDING GEAR SYSTEM.

3-103. Landing gear system trouble may result from one or a combination of electrical, hydraulic or mechanical failures. In order to expedite the remedy, the following systematic method is suggested to aid in isolating the trouble.

- a. Determine and obtain necessary test equipment.
- b. Thoroughly study landing gear system to determine classification and probable cause of trouble.
- c. Select most logical cause of classified failure and determine most accessible location.
- d. Determine how the condition can be corrected.
- e. Re-check operation of system to prove applied remedy.

TEST EQUIPMENT: D-C voltmeter.  
Ohmmeter.

SYSTEM CONDITIONS: Airplane on jacks.  
28-volt d-c power applied to airplane.  
Utility hydraulic system is connected to a hydraulic test stand capable of delivering 3000 psi at 5.8 gpm.  
LG. & WING FOLD and GROUND SAFETY & OVERVOLTAGE circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>LANDING GEAR CONTROL HANDLE IN "UP" POSITION, DOORS REMAIN CLOSED AND LANDING GEARS DO NOT RETRACT.</b>			
Door-open solenoid on landing gear and door control valve not operating electrically due to one or a combination of the following:  a. Defective control valve.	<div style="border: 2px solid black; padding: 5px; text-align: center;"><b>WARNING</b></div> <p>Remove hydraulic pressure from airplane before making these checks or door may open and landing gear may retract unexpectedly, causing serious injury to personnel.</p> <p>Check between test point GA and ground.</p>	28 volts dc.	Replace defective landing gear and door control valve. (Refer to paragraph 3-110.)
		Zero volts.	Continue trouble shooting procedure.
b. Nose landing gear uplock switch improperly rigged or defective.	Check between test point GB and ground.	28 volts dc.	Properly rig or replace defective nose landing gear uplock switch. (Refer to paragraphs 3-116 and 3-117.) Perform wire segment check.
		Zero volts.	Continue trouble shooting procedure.
c. Defective wiring.	Check between test point GC and ground.	28 volts dc.	Continue trouble shooting procedure.
d. Landing gear control switch defective.		Zero volts.	Check for 28 volts dc between test points G, GD and GE and ground. Replace defective landing gear control switch or wiring.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>LANDING GEAR CONTROL HANDLE IN "UP" POSITION, DOORS REMAIN CLOSED AND LANDING GEARS DO NOT RETRACT. (Cont)</b>		
c. Nose landing gear uplock switch defective or improperly adjusted.	Gain access to nose landing gear uplock switch in nose landing gear wheel well and remove cover plate. With landing gear control handle in "UP" position and electrical power present, use voltmeter and check voltage between terminal of wire G54D18 and ground. If 28 volts dc is indicated, nose landing gear uplock switch is improperly adjusted or defective.	Properly adjust nose gear uplock switch (paragraph 3-117) or replace defective switch.
d. Landing gear retract control relay (L.G. RETRACT CONTROL) defective.	Gain access to landing gear retract control relay (L.G. RETRACT CONTROL) through left-hand radio bay access panel and remove relay from canopy deck relay panel. With landing gear control handle in "UP" position and electrical power present, use voltmeter and check voltage between pinhole "A" and pinhole "B" of receptacle. If 28 volts dc is indicated, landing gear retract control relay (L.G. RETRACT CONTROL) is defective.	Replace defective relay.
e. Landing gear control switch defective.	Gain access to landing gear control switch by reclining instrument panel. With landing gear control handle in "UP" position and electrical power present, use voltmeter and check voltage between terminal of wire A4A18 and ground. If 28 volts dc is not indicated, check voltage between terminals of wires G1A18 and G1B18 and ground. If 28 volts dc is indicated at both terminals, landing gear control switch is defective.	Replace defective switch.
Hydraulic unit in landing gear door open system by-passing fluid to return.	With hydraulic pressure on air-plane, position pressure selector switch to "UTILITY" and ensure that 3000 psi is present. Move landing gear control from "DOWN" to "UP" and check for pressure drop. If pressure drops and does not stabilize at 3000 psi when control handle is in "UP" position, a unit in the door-open system is by-passing fluid to return.	Replace defective unit.

3-82



PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>LANDING GEAR CONTROL HANDLE IN "UP" POSITION, DOORS OPEN, LANDING GEARS DO NOT RETRACT. (Cont)</b>			
c. Defective or improperly adjusted door-open sequence switches. (Cont)	Check between test point GW and ground.	28 volts dc.	Replace defective wire to control valve.
		Zero volts.	Properly adjust or replace defective left-hand main gear strut door-open sequence switch. (Refer to paragraphs 3-116 and 3-117.)
Hydraulic unit in landing gear up system by-passing fluid to return.	With hydraulic pressure on airplane, position HYD PRESS SELECTOR switch to "UTILITY." Place landing gear control handle to "UP" position and check pressure gage for pressure build-up and stabilization after doors reach the full open position. If pressure remains low after doors are full open, hydraulic unit in landing gear up system is by-passing fluid to return.		Replace defective unit.
Landing gear emergency extension control system improperly rigged, permitting override lever to override gear-up and door-closed solenoid.	Visually check for condition through left-hand main gear wheel well access panel.		Properly rig landing gear emergency extension control system. (Refer to paragraph 3-199.)
<b>LANDING GEAR CONTROL HANDLE IN "UP" POSITION, LANDING GEARS UP AND LOCKED, DOORS WILL NOT CLOSE.</b>			
Door-closed solenoid on landing gear and door control valve not operating electrically due to one or a combination of the following:	<div style="border: 1px solid black; padding: 5px; text-align: center; margin-bottom: 10px;"><b>WARNING</b></div> Remove hydraulic pressure from airplane before making these checks or doors might close unexpectedly, resulting in serious injury to personnel.		
a. Defective landing gear and door control valve.	Check between test point GX and ground.	28 volts dc.	Replace defective landing gear and door control valve. (Refer to paragraph 3-110.)
		Zero volts.	Continue trouble shooting procedure.
b. Defective landing gear control switch or wiring.	Check between test point GY and ground.	28 volts dc.	Replace defective wiring or landing gear control switch.
		Zero volts.	Continue trouble shooting procedure.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
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**LANDING GEAR CONTROL HANDLE IN "UP" POSITION, LANDING GEARS UP AND LOCKED, DOORS WILL NOT CLOSE. (Cont)**

<p>c. Defective or improperly rigged landing gear uplock switch.</p> <p><b>Note</b> The landing gear uplock switches are connected in series and must be checked in the order listed with all switches in the uplocked position.</p>	Check between test point GZ and ground.	28 volts dc.	Continue trouble shooting procedure.
		Zero volts.	Properly rig or replace defective nose landing gear uplock switch. (Refer to paragraphs 3-116 and 3-117.)
	Check between test point GAA and ground.	28 volts dc.	Continue trouble shooting procedure.
		Zero volts.	Properly rig or replace defective left-hand main landing gear uplock switch. (Refer to paragraphs 3-116 and 3-117.)
	Check between test point GAB and ground.	28 volts dc.	No action.
		Zero volts.	Properly rig or replace defective right-hand main landing gear uplock switch. (Refer to paragraphs 3-116 and 3-117.)

**LANDING GEAR CONTROL HANDLE IN "DOWN" POSITION, GEARS REMAIN UP AND LOCKED, DOORS WILL NOT OPEN.**

Both the door-open and gear-down solenoids on the landing gear and door control valve not operating electrically due to one or a combination of the following:

**WARNING**

Remove hydraulic pressure from airplane before making these checks as landing gears or doors might operate unexpectedly, resulting in serious injury to personnel.

a. Defective gear-down solenoid on gear and door control valve.

Check between test point GAC and ground.

28 volts dc.

Replace defective landing gear and door control valve. (Refer to paragraph 3-110.)

Zero volts.

Continue trouble shooting procedure.

b. Defective wiring or landing gear control switch.

Check between test points G, GD, GAD and ground.

28 volts dc.

Replace defective wiring to control valve.

Zero volts.

Replace defective control switch or wiring.

c. Defective door-open solenoid on landing gear and door control valve.

Check between test point GA and ground.

28 volts dc.

Replace defective landing gear and door control valve. (Refer to paragraph 3-110.)

Zero volts.

Continue trouble shooting procedure.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>LANDING GEAR CONTROL HANDLE IN "DOWN" POSITION, GEARS REMAIN UP AND LOCKED, DOORS WILL NOT OPEN. (Cont)</b>			
d. Defective wiring or LD GR SW DOWN relay.	Check between test point GAE and ground.	28 volts dc.	Replace defective wiring to control valve.
		Zero volts.	Continue trouble shooting procedure.
	Check between test points GAF, GAG and ground.	28 volts dc.	Perform wire segment check through landing gear down-lock switches.  <b>Note</b> Landing gear must be partially lowered to make this check.
		Zero volts.	Replace defective LD GR SW DOWN relay or wiring.

**LANDING GEAR CONTROL HANDLE IN "DOWN" POSITION, GEARS UNLOCKED, DOORS OR DOOR WILL NOT OPEN.**

<p>Door-open solenoid on landing gear and door control valve not operating electrically due to one or a combination of the following:</p> <p>a. Defective control valve or wiring.</p> <p>b. All three landing gear downlock switches improperly rigged or defective.</p> <p>c. Defective LD GR SW DOWN relay or wiring.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"><b>WARNING</b></div> <p>Remove hydraulic pressure from airplane before making the checks as gears and doors might operate unexpectedly, resulting in serious injury to personnel.</p>		
	Check between test point GA and ground.	28 volts dc.	Replace defective landing gear and door control valve. (Refer to paragraph 3-110.)
		Zero volts.	Continue trouble shooting procedure.
	Check between test point GAE and ground.	28 volts dc.	Replace defective wiring to control valve.
		Zero volts.	Continue trouble shooting procedure.
	Check between test points GAF, GAG and ground.	28 volts dc.	Perform wire segment check through landing gear down-lock switch.  <b>Note</b> Landing gear must be partially lowered to make this check.
		Zero volts.	Replace defective LD GR SW DOWN relay or wiring.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>LANDING GEAR CONTROL HANDLE IN "DOWN" POSITION, GEARS UNLOCKED, DOORS OR DOOR WILL NOT OPEN. (Cont)</b>			

Hydraulically operated door improperly rigged.	Check rigging. (Refer to paragraphs 3-140, 3-148 and 3-171.)		Properly rig doors.
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**LANDING GEAR CONTROL HANDLE IN "DOWN" POSITION, DOORS OPEN, GEARS OR GEAR WILL NOT EXTEND.**

Gear-down solenoid on landing gear and door control valve not operating electrically due to one or a combination of the following:	<div style="border: 1px solid black; padding: 5px; text-align: center;"><b>WARNING</b></div> <p>Remove hydraulic pressure from airplane before making these checks or gears might operate unexpectedly, resulting in serious injury to personnel.</p>		
a. Defective control valve.	Check between test point GAC and ground.	28 volts dc.	Replace defective landing gear and door control valve. (Refer to paragraph 3-110.)
		Zero volts.	Continue trouble shooting procedure.
b. Defective landing gear control switch or wiring.	Check between test points G, GD, GAD and ground.	28 volts dc.	Replace defective wiring to control valve.
		Zero volts.	Replace defective landing gear control switch or wiring.
Landing gear priority valve stuck closed.			Replace priority valve.
Hydraulic unit in door-open system by-passing fluid to return.	With hydraulic pressure on airplane, position HYD PRESS SELECTOR switch on instrument panel to "UTILITY." When the landing gear control handle is moved to "DOWN" position and the hydraulically operated doors reach the full open position, check for a pressure build-up or stabilization. If pressure remains low after doors are full open, hydraulic unit in door-open system is by-passing fluid to return.		Replace defective unit.
Broken or binding linkage to landing gear uplocks. Improperly rigged landing gear uplock mechanism.	Visually check for condition. (Refer to paragraphs 3-125 and 3-163.)		Replace defective linkage or properly adjust landing gear. (Refer to paragraphs 3-125 and 3-163.)

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY	
<b>LANDING GEAR CONTROL HANDLE "DOWN," GEARS DOWN AND LOCKED, DOORS REMAIN OPEN.</b>				
Door-closed solenoid on landing gear and door control valve not operating electrically due to one or a combination of the following:	<div><b>WARNING</b></div> <p>Remove hydraulic pressure from airplane before making these checks or doors might close unexpectedly, resulting in serious injury to personnel.</p>			
a. Defective control valve.		Check between test point GX and ground.	28 volts dc.	Replace defective landing gear and door control valve. (Refer to paragraph 3-110.)
			Zero volts.	Continue trouble shooting procedure.
b. Defective wiring or landing gear control switch.		Check between test point GAH and ground.	28 volts dc.	Continue trouble shooting procedure.
			Zero volts.	Replace defective landing gear control switch or wiring.
c. Landing gear downlock switch defective or improperly adjusted.		Check between test point GAJ and ground.	28 volts dc.	Continue trouble shooting procedure.
			Zero volts.	Properly rig or replace defective nose landing gear downlock switch. (Refer to paragraphs 3-116 and 3-117.)
		Check between test point GAK and ground.	28 volts dc.	Continue trouble shooting procedure.
			Zero volts.	Properly rig or replace defective left-hand main landing gear downlock switch. (Refer to paragraphs 3-116 and 3-117.)
		Check between test point GAL and ground.	28 volts dc.	Replace defective wiring to control valve.
			Zero volts.	Properly rig or replace defective right-hand main landing gear downlock switch. (Refer to paragraphs 3-116 and 3-117.)
<b>ELECTRICAL POWER FAILURE.</b>				
Defective circuit breaker.	Check between test points PDA, PGR and ground.	28 volts dc.	Replace defective circuit breaker.	
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.	

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>LANDING GEAR CONTROL HANDLE IN "DOWN" POSITION, DOORS OPEN, ONE GEAR FAILS TO LOCK DOWN.</b>			
Drag or side brace linkage broken or out of adjustment.	Check drag and side brace linkage for broken or binding parts.		Replace broken parts. Adjust and/or replace drag and side brace. (Refer to paragraphs 3-126 and 3-163.)

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>LANDING GEAR CONTROL HANDLE "DOWN," GEARS DOWN AND LOCKED, DOORS REMAIN OPEN. (Cont)</b>		

a. Landing gear down-lock switch defective or improperly adjusted. (Cont)

power present and nose gear and left-hand main gear down and locked, use voltmeter and check voltage between terminal of wire G59A18 and ground. If 28 volts dc is not indicated, left-hand main gear downlock switch is defective or improperly adjusted.

Gain access to right-hand main gear downlock switch through right-hand main gear strut well and remove cover plate. With landing gear control handle in "DOWN" position, electrical power present and all three gears down and locked, use voltmeter and check voltage between terminal of wire G60B18 and ground. If 28 volts dc is not indicated, right-hand main gear downlock switch is defective or improperly adjusted.

**Note**

Any one gear not in the down and locked position will prevent doors from closing.

**LANDING GEAR CONTROL HANDLE IN THE "DOWN" POSITION, DOORS OPEN, ONE GEAR FAILS TO LOCK DOWN.**

Drag or side brace linkage broken or out of adjustment.

Check drag and side brace linkage for broken or binding parts.

Replace broken parts. Adjust and/or replace drag and side brace. (Refer to paragraphs 3-126 and 3-163.)

**3-104. OPENING LANDING GEAR HYDRAULICALLY OPERATED DOORS ON THE GROUND.**

3-105. To open the landing gear hydraulically operated doors with the weight of the airplane on the landing gears, pull the landing gear emergency release handle (EMG. LDG. GR. RELEASE). This will unlock and partially open the wheel doors. The wheel doors can then be pulled manually to the full open position. When this method is used for opening the landing gear wheel doors, the nose gear emergency extension selector valve must be reset to the normal position before a normal operation is effected. The main landing gear strut doors must be opened individually by inserting a drift pin into the access hole provided in the skin of the strut door and pushing directly up. This will trip the lock mechanism over-center and permit the strut door to open.

**WARNING**

Care must be taken to ensure against personnel being injured by inadvertent closing of the hydraulically operated doors. No hydraulic power should be present in the utility system at any time while performing maintenance in the wheel well. The landing gear and wing fold circuit breaker (LG & WING FOLD) should also be pulled while maintenance is being performed. Doors should be closed immediately upon completion of maintenance in the wheel well.



3-106. OPERATIONAL CHECK OF  
LANDING GEAR SYSTEM.

3-107. To check landing gear system operation, proceed as follows:

- a. Place airplane on jacks. (Refer to paragraph 1-14.)
- b. Remove downlock safety pins from gear.
- c. Connect external power source to airplane.
- d. Connect hydraulic test stand to ground test connection panel and set to operate at 5.8 gpm at 3000 psi.

**CAUTION**

- Ensure that the lower engine access door is raised and latched prior to operating the gears or structural damage to the main gear wheel doors may result.
- When airplane is on jacks, make sure the nose gear wheel is centered fore and aft before retracting landing gears or structural damage may result.
- e. Push LG & WING FOLD (left-hand forward console), GROUND SAFETY & OVERVOLTAGE (left-hand radio bay circuit-breaker panel), LDG APPROACH LIGHT & LANDING GEAR WARNING (left-hand forward console) and OIL PRESS IND, TRIM IND & LG POSITION IND (left-hand forward console) circuit breakers in.

**WARNING**

Make sure all personnel are clear of landing gear before operating.

- f. Place landing gear control handle to "UP" position. The warning light in the control handle should illuminate, the door locks should release and the hydraulically operated doors should start opening. When all hydraulically operated doors reach the full open position, the landing gear downlock pin should release and the corresponding position indicator in the cockpit should show a "barber pole" effect. When the landing gears reach the up and locked position, the hydraulically operated doors should close; when the doors reach the closed and locked position, the warning light should go out and the corresponding position indicator in the cockpit should show the word "UP." Time for complete retraction cycle of gear and door operation should not exceed 7 seconds or be less than 5 seconds.

**Note**

Any one door not in the full open position should prevent gears from retracting. Any one gear not in the uplocked position should prevent door from closing.

- g. Place landing gear control handle to the "DOWN" position. The warning light in the landing gear control handle should illuminate, the door lock should release and the doors should start opening. The corresponding position indicator in the cockpit should show a "barber pole" effect. When the hydraulically operated doors reach the full open position, the landing gear uplocks should release and the gear should extend to the down and locked position; when the landing gears reach the down and locked position, the corresponding position indicator in the cockpit should show a tire, the warning light should go out and the hydraulically operated doors should close. The complete extension cycle of gear and door operation should not exceed 7 seconds or be less than 5 seconds.

**Note**

Gears and doors should not make contact at any point while doors are opening and gear is extending.

- h. With a suitable means of controlling input flow and pressure, retract gears slowly enough so that the gears have no inertia as they retract. Maximum pressure required to lock the gears up should not exceed 2500 psi. If gears do not lock at this pressure, check for mechanical interference or check landing gear rigging. (Refer to paragraphs 3-125 and 3-163.) Extend the landing gear.
- i. With the test stand still set for low output, check the landing gear and door control valve by retracting the gear to approximately the three-fourths up position and cutting off electrical power by pulling the LG & WING FOLD circuit breaker. The up motion should cease and the main gear should fall within 30 degrees of full down position within 8 seconds. Reposition LG & WING FOLD circuit breaker in and permit gear to retract and lock. When the hydraulically operated doors are approximately three-fourths of the way closed, cut off electrical power by pulling the LG & WING FOLD circuit breaker. The door should fall to the open position within 8 seconds.
- j. Reposition the LG & WING FOLD circuit breaker in and operate landing gears slowly through a complete cycle. While landing gears are operating, thoroughly check gears and doors for adequate clearance between wire bundles, flex hoses and structure.
- k. Permit the gear to extend and lock and permit the doors to close and lock.
- l. Thoroughly check landing gear and door hydraulic system for external leaks.

**Note**

Operational check of landing gear emergency extension system may be accomplished in conjunction with the normal system check. (Refer to paragraph 3-198.)

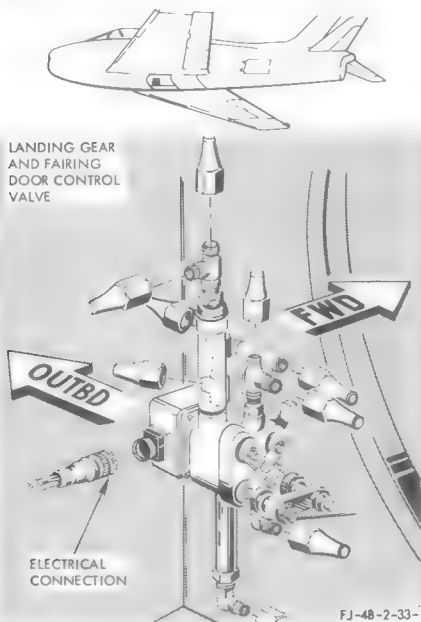
- m. Disconnect external electrical power source.
- n. Exhaust pressure and disconnect hydraulic test stand.

- o. Install downlock safety pins.
- p. Remove jacks from airplane.

### 3-108. LANDING GEAR AND FAIRING DOOR CONTROL VALVE.

3-109. The landing gear and fairing door control valve is located on the lower left-hand side of the forward bulkhead in the engine bay (figure 3-29). Access to the control valve is gained through the access panel in the left main landing gear wheel well. The control valve includes four separate solenoid-operated selector valves with a common pressure and return port in a single housing. Each valve consists of a sliding spool, a return spring, a solenoid and an override button. When in the energized position, each valve directs pressure to perform one function of landing gear or door sequencing. When in the de-energized position, each valve provides a return port for the same portion of the system to which it previously directed pressure. The override button is incorporated on the control valve to manually override the solenoid and to ensure that the solenoid returns to its de-energized position in the event of a hydraulic or electrical power failure. The door-close and gear-up solenoid override buttons are the only buttons depressed by mechanical linkage when the emergency extension handle is pulled.

### 3-110. REMOVING AND INSTALLING LANDING GEAR AND FAIRING DOOR CONTROL VALVE.



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## REMOVING

- 1** Remove engine from airplane. (Refer to paragraph 5-7.)
- 2** Open landing gear wheel door. (Refer to paragraph 3-104.)
- 3** Remove access panel in left main landing gear wheel well.
- 4** Break safety wire and disconnect electrical connection from control valve.
- 5** Disconnect the 10 hydraulic lines from control valve and cap openings.
- Note** Remove hydraulic lines as necessary to aid in removal of valve. Use crowfoot to aid in disconnecting hydraulic lines.
- 6** Remove clamp securing fuel line to priority valve.
- 7** Remove control valve from airplane.

**Note** Landing gear priority valve is attached to control valve at gear down outlet port and will be removed with valve.

## INSTALLING

- 1** Position control valve on bulkhead mounting support and install three mounting bolts and washers.
- 2** Remove caps and connect the 10 hydraulic lines to control valve.

**Note** Due to the restricted area, some of these lines are extremely hard to start and tighten. Use crowfoot to aid in tightening. Care must be used to prevent damage to fittings and hydraulic line.

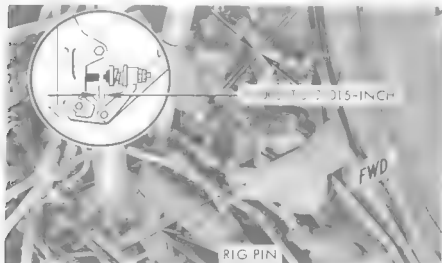


- 3** Connect electrical connection to control valve and safety with AN995F32 lockwire.

FJ-48-2-33-2

**4** Install clamp on priority valve securing fuel line.

**5** With emergency extension release handle in normal position, insert a 5/16-inch rig pin through sector support on bulkhead 180 and adjust emergency extension manual override linkage to obtain from 0.005- to 0.015-inch clearance between linkage and override button on control valve.



**6** Check landing gear system. (Refer to paragraph 3-106.)

**7** Install engine in airplane. (Refer to paragraph 5-7.)

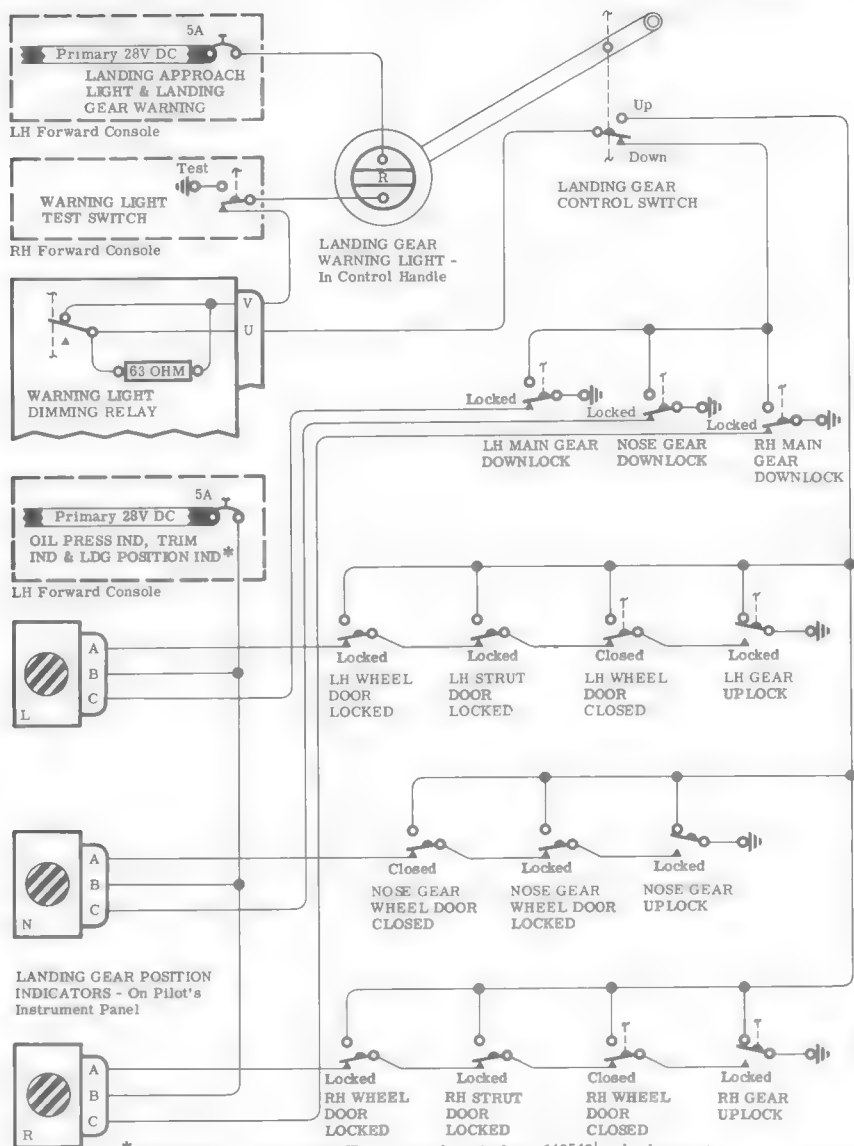
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### 3-111. LANDING GEAR SYSTEM PRIORITY VALVE.

3-112. The landing gear system priority valve is located on the gear and door control valve at the gear down outlet port (figure 3-29). The priority valve is installed in the gear-down line to prevent flow of hydraulic pressure to the gear actuating and uplock cylinders until the hydraulically operated doors are full open. This prevents the landing gears and doors from making contact during the extending cycle. The priority valve unseats at approximately 1000 psi. The priority valve contains two spring-loaded valves. One valve has unbalanced effective areas so that a sufficient pressure increase (approximately 1000 psi) at the inlet port will force the valve open. The other valve opens to permit free flow in the opposite direction only.

### 3-113. LANDING GEAR POSITION INDICATING AND WARNING SYSTEM.

3-114. The landing gear position indicating and warning system consists of a position indicator for each gear, a red warning light and hermetically sealed micro-switches. The position indicators are located on the lower left-hand side of the instrument panel and in relation to the airplane form the same pattern as the landing gear. The red warning light is installed inside the landing gear control handle. The hermetically sealed switches are adjacent to and operated by the fairing door locks, the gear uplocks and the gear downlocks. The position indicating and warning system provides visual indication of landing gear condition. Moving the landing gear control to the "UP" position electrically sequences the gear and door control valves for the retraction cycle. The red light in the control handle illuminates simultaneously. With the release of each gear downlock, the wheel disappears and a "barber pole" effect appears in the corresponding indicator dial. When the landing gears reach the up and locked position and the fairing doors are closed and locked, the "barber pole" effect disappears from the corresponding indicator dial and the word "UP" appears. The red light also goes out. Moving the landing gear control handle to the "DOWN" position electrically energizes the control valves to open the doors and extend the gears. The red light in the control handle illuminates simultaneously. As each door lock is released, the word "UP" disappears and a "barber pole" effect appears in the corresponding dial of the position indicators. As each gear locks in the down position, the "barber pole" effect disappears and a wheel appears in that dial. When all three gears reach the down and locked position, the red warning light goes out. Gear position indication during emergency extension is the same as for normal extension, except in the case of an electrical system failure. (See figure 3-37.)



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Figure No. 3-37. Landing Gear Position Indicating and Warning System Schematic

3-115. TROUBLE SHOOTING LANDING GEAR POSITION INDICATING AND WARNING SYSTEM.

TEST EQUIPMENT: D-C voltmeter.  
Ohmmeter.

SYSTEM CONDITIONS: Airplane on jacks.  
Hydraulic power connected to airplane.  
28-volt d-c power applied to airplane.  
Landing gear circuit breakers engaged.  
Instrument and console lights not energized.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
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**LANDING GEAR CONTROL HANDLE "DOWN," GEAR DOWN AND LOCKED, WARNING LIGHT ILLUMINATED.**

One or more landing gear downlock switches improperly adjusted or defective.	Check landing gear position indicators. If one of the indicators shows blue and white stripes (barber pole effect), the downlock switch for that gear is either faulty or improperly adjusted. Continue to trouble shoot if all indicators show wheels.		Properly adjust or replace defective downlock switch. (Refer to paragraphs 3-116 and 3-117.)
Short to ground in warning light circuit.	Perform wire segment continuity check.		Replace defective wiring.

**LANDING GEAR CONTROL HANDLE "DOWN," LANDING GEAR DOWN AND LOCKED, WARNING LIGHT NOT ILLUMINATED, POSITION INDICATOR(S) SHOWS BARBER POLE EFFECT.**

Defective indicator or open wire in position indicating circuit.	Check between test point GBA, GBB, or GBC and ground.	Zero ohms.	Replace defective indicator.
		Other than zero ohms.	Perform wire segment continuity check and replace defective wire.
Defective indicator or power failure to indicator.	Check between test point GBD and ground.	28 volts dc.	Replace defective indicator.
		Zero volts.	Replace open wire between test points GBD and GBE. If no voltage is present at test point GBE, refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.

**LANDING GEAR CONTROL HANDLE "UP," GEAR AND DOORS NOT LOCKED UP, WARNING LIGHT NOT ILLUMINATED, POSITION INDICATOR(S) SHOWS BARBER POLE EFFECT.**

Lamp in control handle burned out or open circuit.	Check between test point GBF and ground.	Zero ohms.	Replace lamp.
		Other than zero ohms.	Perform wire segment continuity check and replace defective wire.
	Check continuity between test points G1 and G2.	Zero ohms for daylight operation or 63 ohms for night operation.	No action.
		Other than zero or 63 ohms.	Replace defective warning light dimming relay.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>LANDING GEAR CONTROL HANDLE "UP," GEAR AND DOORS LOCKED UP, WARNING LIGHT ILLUMINATED, POSITION INDICATOR(S) SHOWS BARBER POLE EFFECT.</b>			
Defective or improperly adjusted gear or door closed or locked switches.	Check between test points GBG, GBH, GBJ and ground.	Zero ohms.	Replace defective indicator.
		Other than zero ohms.	Perform continuity check of wiring to switches. Replace defective wiring. If wiring is not defective, continue trouble shooting procedure.
	<p><b>Note</b></p> <p>The following check cannot be accomplished with the landing gear up and the doors closed. With doors open and gear down, manually actuate and maintain the gear uplock and door closed and locked switches in their uplocked condition.</p>		
	Check nose gear between test points GBK, GBL or GBM and ground.	Zero ohms.	Replace defective indicator.
		Other than zero ohms.	Properly adjust or replace defective switch at test point indicating other than zero ohms or wiring to preceding switch. (Refer to paragraphs 3-116 and 3-117.)
Defective indicator or power failure to indicator.	Check left-hand gear between test point GBN, GBP, GBQ or GBR and ground.	Zero ohms.	Replace defective indicator.
		Other than zero ohms.	Properly adjust or replace defective switch at test point indicating other than zero ohms or wiring to preceding switch. (Refer to paragraphs 3-116 and 3-117.)
	Check right-hand gear between test points GBS, GBT, GBU or GV and ground.	Zero ohms.	Replace defective indicator.
		Other than zero ohms.	Properly adjust or replace defective switch at test point indicating other than zero ohms or wiring to preceding switch. (Refer to paragraphs 3-116 and 3-117.)
	Check between test point GBD and ground.	28 volts dc.	Replace defective indicator.
		Zero volts.	Replace open wire between test points GBD and GBE. If no voltage is present at GBE, refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>WARNING LIGHT ILLUMINATES AND ONE OR MORE POSITION INDICATORS SHOW BARBER POLE EFFECT WHEN G-LOAD IS PRESENT DURING FLIGHT.</b>			

One or more fairing door lock mechanisms improperly adjusted permitting respective door to open enough to actuate the locked or closed switches to the door open position.	Check all fairing door lock mechanisms for proper adjustment. (Refer to paragraphs 3-140, 3-148 and 3-171.)		Properly adjust door lock mechanisms.
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**ELECTRICAL POWER FAILURE.**

Defective circuit breaker.	Check between test points PDB, PDM and ground.	28 volts dc.	Replace defective circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.

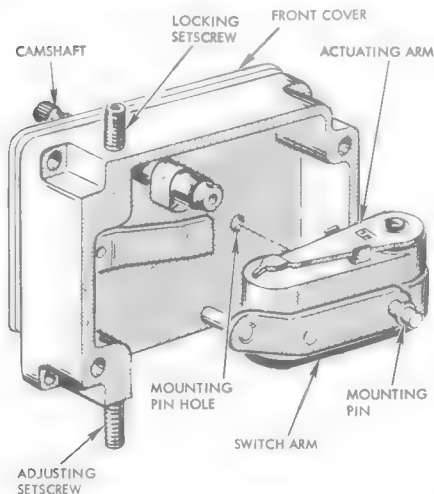


## 3-116. ASSEMBLING AND ADJUSTING LANDING GEAR SYSTEM HERMETICALLY SEALED MICRO-SWITCHES.

## BENCH ADJUSTMENT FOR SINGLE SWITCH UNIT

**1** With switch case held in position shown and micro-switch locking and adjusting setscrews backed out, install camshaft with splined end on side of case desired for left or right part.

**2** Install switch arm and mounting pin on micro-switch with switch arm turned up toward actuating arm.

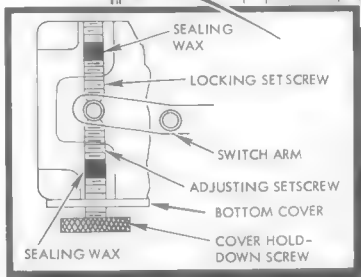
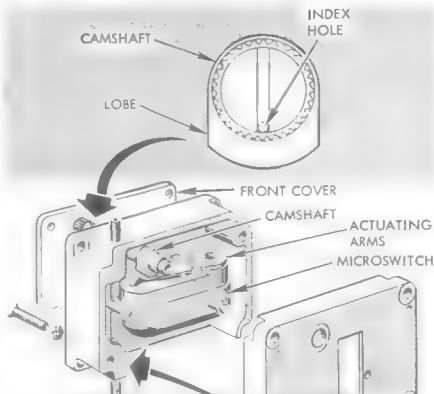


**3** Slide microswitch into place, with mounting pin mating with hole in rear cover and with actuating arm up in a position to contact camshaft.

**4** Hold microswitch assembly in place, slide front cover over camshaft and mounting pin and install screws in cover.

**5** Turn camshaft so that lobe of cam is toward, and perpendicular to, microswitch actuating arm. The hole in the end of the camshaft indicates the center of the lobe of the cam.

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**6** Move adjusting setscrew in slowly until switch actuates; then continue one-half turn past point of actuation.

**Note** A continuity light may be used to set switch adjustment. Connect electrical leads to proper terminals on microswitch and slowly rotate splined shaft until switch is actuated (clicks) and light comes on.

**7** Tighten locking setscrew securely and plug setscrew holes with sealing wax, leaving enough room to receive bottom cover.

## BENCH ADJUSTMENT FOR MULTIPLE SWITCH UNIT

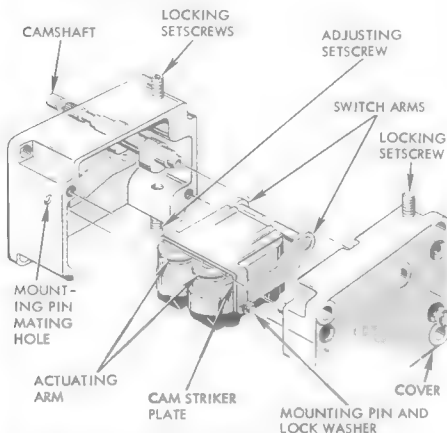
**1** With switch case held in position shown and micro-switch locking and adjusting setscrews backed out, install camshaft with splined end on side of case desired for left or right part.

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## Section III Landing Gear System

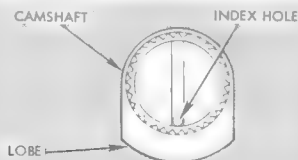
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- 2** Install a right switch arm to one microswitch and a left arm to the other, with actuating arms up to contact camshaft.



- 3** Hold both microswitches together, switch arm pins facing each other; then slide cam striker plate over both switches and install mounting pin through striker plate pivot arms and microswitches. Install lock washer on mounting pin. Slide doubler microswitch assembly into switch with mounting pin mating with hole in rear cover and striker plate up in position to contact camshaft. Hold microswitch assembly in place, slide cover over camshaft and mounting pin and install screws in cover.

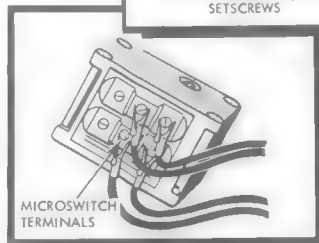
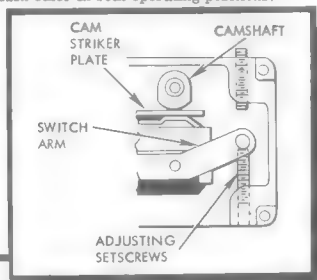
- 4** Turn camshaft so that lobe of cam is toward, and perpendicular to, microswitch striker plate. The hole in the end of the camshaft indicates the center of the lobe of the cam.



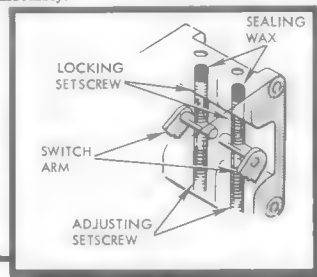
**Note** A continuity light may be used to set switch adjustment. Connect electrical leads to proper terminals on microswitch and rotate splined shaft until switch is actuated (clicks) and light comes on. To check that double microswitch units operate within one degree of each other, connect electrical leads of two continuity lights to proper terminals of microswitches (one set of leads to each microswitch). Slowly rotate splined shaft until switches are actuated and lights come on. If lights do not come on at the same instant, readjust switches.

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- 5** Turn adjusting setscrew of one microswitch in slowly until switch actuates; then continue one-half turn past point of actuation. Repeat for second microswitch. Adjust microswitches to operate within one degree of each other in both operating positions.



- 6** Tighten locking setscrews securely and plug setscrew holes with sealing wax, leaving enough room to receive bottom cover hold-down screw; then install bottom cover assembly.



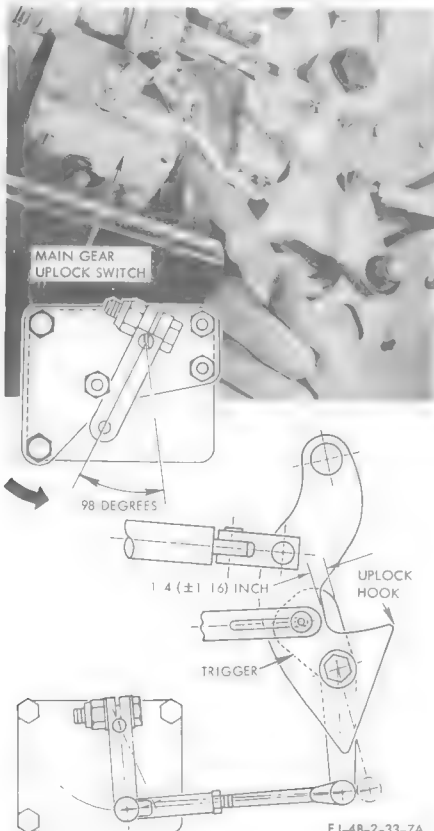
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## 3-117. ADJUSTING LANDING GEAR SYSTEM SEQUENCE, WARNING AND POSITION INDICATING SWITCHES.

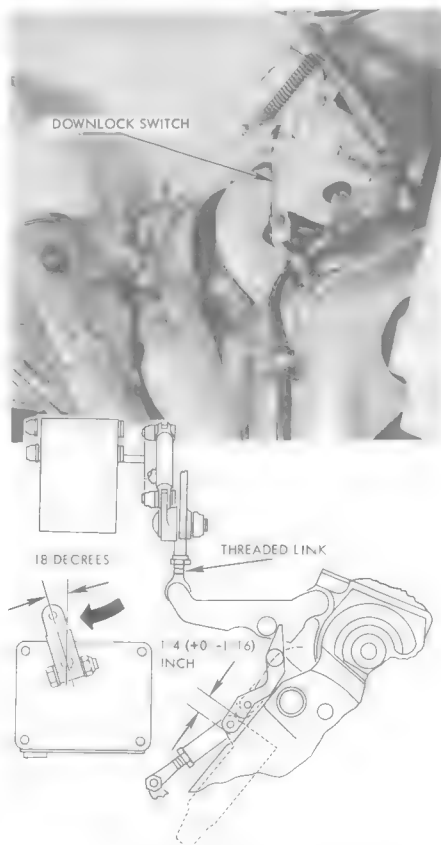
**Note** Before switches are installed, switch arm must be installed on splined shaft. Rotate shaft in direction indicated until switch actuates; then, install arm in position shown and secure. A drilled hole in end of switch shaft indicates center of lobe of switch cam. Do not change position of switch arm on splined shaft once bench setting is complete and switch assembly is installed on airplane.

**1** MAIN GEAR UPLOCK SWITCH.

With main gear down and the uplock hook in locked position, adjust the uplock switch threaded linkage to actuate switch when the trigger is  $1/4$  ( $\pm 1/16$ ) inch in throat of hook.

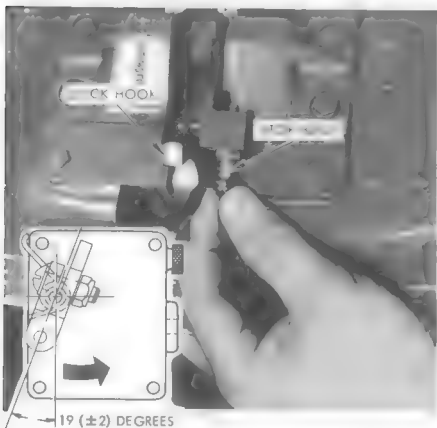
**2** MAIN GEAR DOWNLOCK SWITCH.

Adjust threaded linkage of downlock switch to actuate switch when downlock pin has moved toward the locked position  $1/4$  ( $+0/-1/16$ ) inch.

**3** MAIN GEAR STRUT DOOR CLOSED AND LOCKED SWITCH.

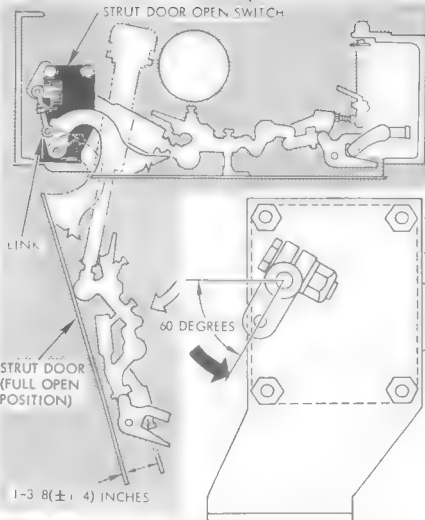
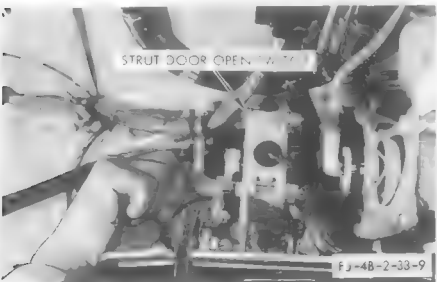
With strut door open, adjust stop bolt to clear the switch actuating arm when the door is in the closed position. With gear down, wheel door open and strut door closed, adjust stop bolt out against switch actuating arm until switch actuates. Turn stop bolt three complete turns beyond switch actuation point and secure locknut.

FJ-48-2-33-8



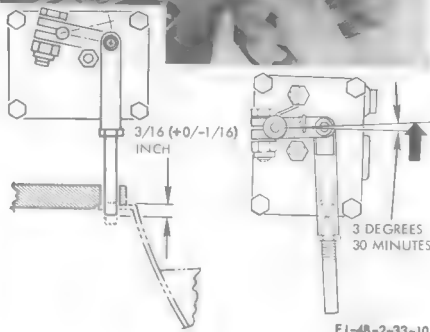
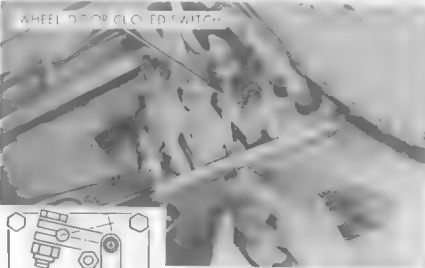
#### 4 MAIN GEAR STRUT DOOR OPEN SWITCH.

Adjust strut door open switch linkage to actuate switch when the strut door is 1-3/8 (±1/4) inches from full open and moving toward open position.



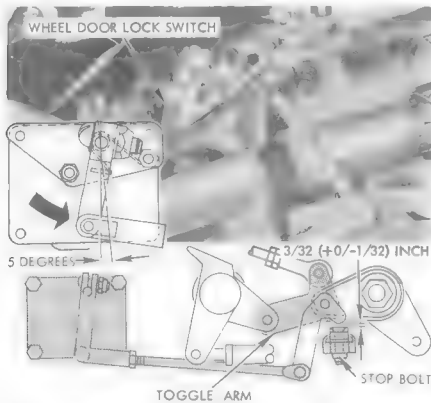
#### 5 MAIN GEAR WHEEL DOOR CLOSED SWITCH.

Adjust wheel door closed switch actuating plunger to actuate switch when plunger is moving up and is 3/16 (+0/-1/16) inch from being flush with wheel door land.

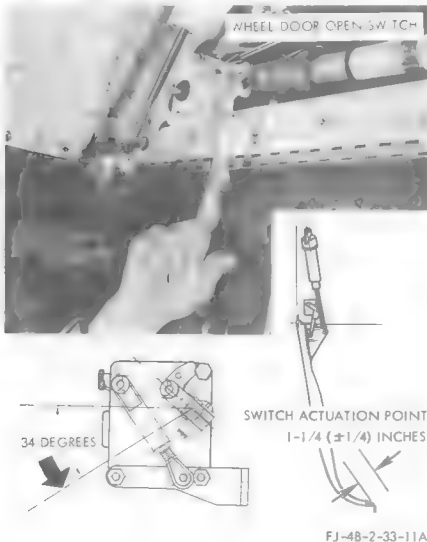


**6 MAIN GEAR WHEEL DOOR LOCK SWITCH.**

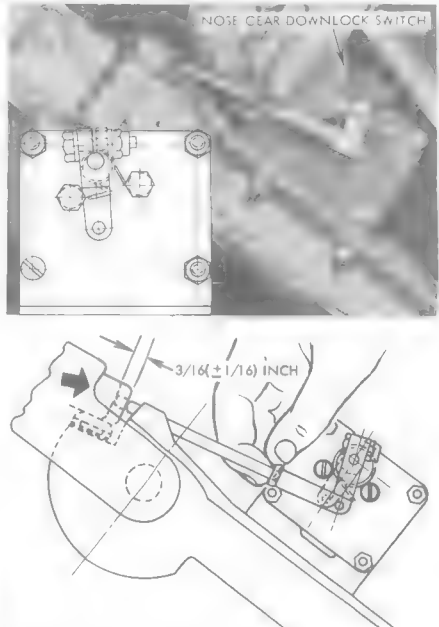
Adjust wheel door lock switch linkage to actuate the switch when the door lock toggle arm is  $3/32$  ( $\pm 0/1/32$ ) inch from forward stop bolt on door locking mechanism.

**7 MAIN GEAR WHEEL DOOR OPEN SWITCH.**

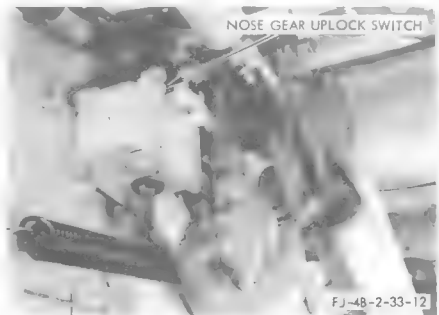
Adjust wheel door open switch linkage to actuate switch when wheel door is  $1-1/4$  ( $\pm 1/4$ ) inches from full open, and moving toward open position.

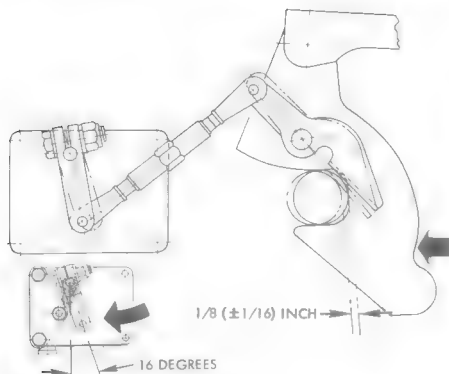
**8 NOSE GEAR DOWNLOCK SWITCH.**

Adjust nose gear downlock switch linkage to actuate switch  $3/16$  ( $\pm 1/16$ ) inch before downlock pin fully engages.

**9 NOSE GEAR UPLOCK SWITCH.**

Adjust nose gear uplock switch threaded linkage to actuate switch when uplock hook is  $1/8$  ( $\pm 1/16$ ) inch from fully locked and moving toward locked position.



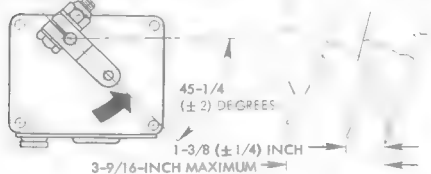


# **10 NOSE GEAR WHEEL DOOR OPEN SWITCH.**

Adjust nose gear wheel door open switch linkage to actuate switch when lower edge of door is 1-3/8 (± 1/4) inches from full open and moving toward open position.



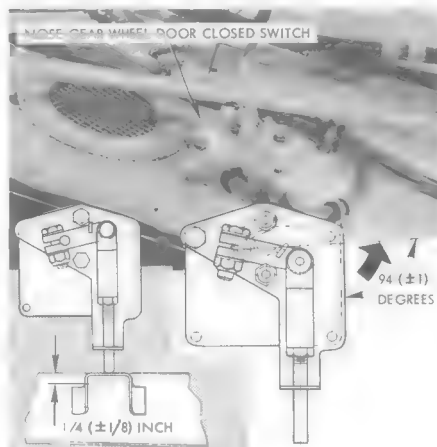
**Note** When the door is moving toward the closed position, switch must deactivate between 1-3/8 (± 1/4) inches minimum and 3-9/16 inches maximum.



FJ-48-2-33-13

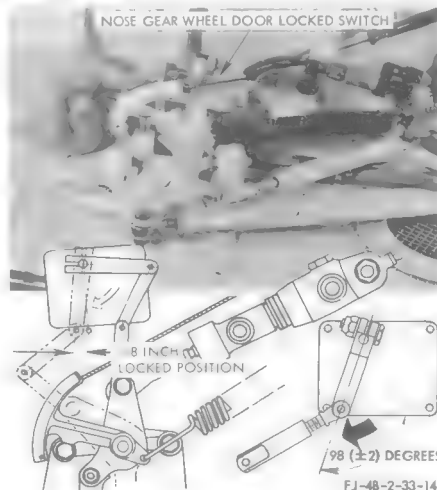
# **11 NOSE GEAR WHEEL DOOR CLOSED SWITCH.**

Adjust nose gear wheel door closed switch linkage to actuate switch when door is 1/4 (± 1/8) inch from fully closed and moving toward closed position.



# **12 NOSE GEAR WHEEL DOOR LOCKED SWITCH.**

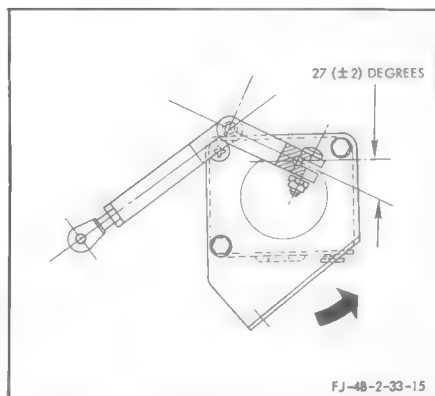
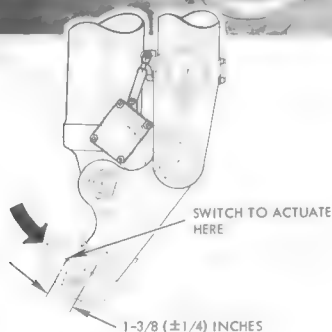
Adjust nose gear wheel door lock switch linkage to actuate switch when door linkage is 1/8 inch from fully locked position.



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**13** GROUND SAFETY SWITCH.

Adjust ground safety switch linkage to actuate switch when the axle is  $1\text{--}3/8$  ( $\pm 1/4$ ) inches from fully extended position.



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**3-118. LANDING GEAR SEQUENCE SWITCHES.**

3-119. Refer to paragraphs 3-88 through 3-100.

**3-120. LANDING GEAR GROUND SAFETY SWITCH.**

3-121. The landing gear ground safety switch is located on the left-hand main landing gear trailing link. It is incorporated in the landing gear retract control circuit to prevent inadvertent retraction of the landing gear while the airplane is on the ground. When the weight of the airplane is on the gear, the ground safety switch is open and the retract control circuit cannot be energized. Should the control handle be placed in the "up" position prior to the airplane leaving the ground, it will be necessary to reposition the control handle "down" to reset the retract control circuit and then select "up" before the landing gears will retract. With the weight of the airplane off the gear, the ground safety switch is actuated to the closed position. The switch provides a ground to energize the landing gear ground safety relay No. 1 which supplies a holding circuit for the landing gear retract control relay (L.G. RETRACT CONTROL).

**3-122. ADJUSTING LANDING GEAR GROUND SAFETY SWITCH.** Refer to paragraph 3-117.**3-123. MAIN LANDING GEAR ASSEMBLY.**

3-124. The main landing gear consists of a left- and right-hand assembly mounted in the wing (figure 3-38). The gears retract up and inboard into the wing and fuselage by means of hydraulic actuating cylinders. Each assembly consists of a knuckle-type gear with a fixed post, a trailing link, an air-oil shock strut, a 26 by 6.6 wheel, a tubeless tire and a brake assembly. The gear pivots on two trunnion pins that are mounted in a box structure. The box structure is an integral part of the wing member at the outboard edge of the strut well. A side brace consisting of two sections is attached to the gear post and wing structure to provide side support of the main landing gear. The side brace folds to enable the landing gear to retract. The gear is locked in the down position by a downlock pin in the side brace. The downlock pin is withdrawn from the side brace sections by the downlock cylinder and is spring-loaded to the locked position. An uplock mechanism, consisting of a roller mounted on the gear post and an uplock hook mounted on the forward strut well structure in the wing, holds the gear in the retracted position. An uplock cylinder and a bungee actuate the uplock hook. The emergency extension control cable provides a means for manually releasing the uplock hook in the event of a hydraulic or electrical power failure. A roller installed on the main gear post prevents structural damage to the strut door during an emergency extension. Each main landing gear is completely faired when in the retracted position by a wheel door, a strut door and a trunnion fairing.



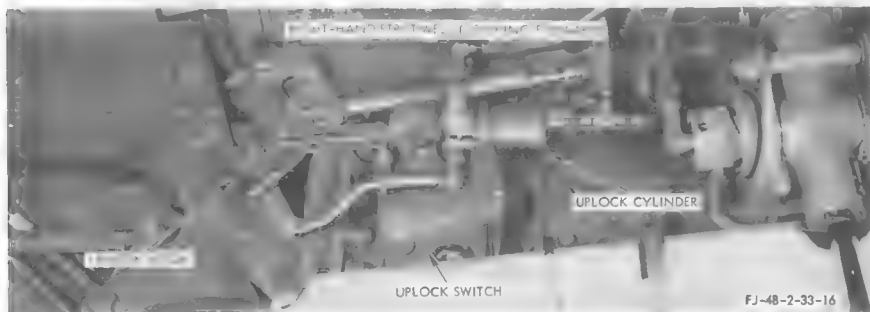
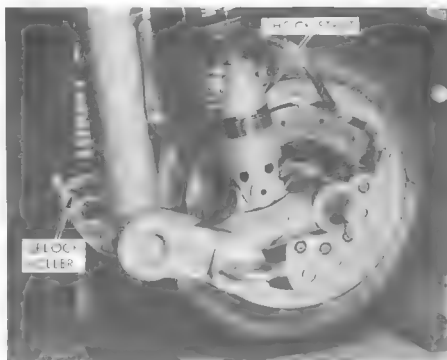


Figure No. 3-38. Main Landing Gear Assembly

## 3-125. REMOVING, INSTALLING AND ADJUSTING MAIN LANDING GEAR ASSEMBLY.

## REMOVING

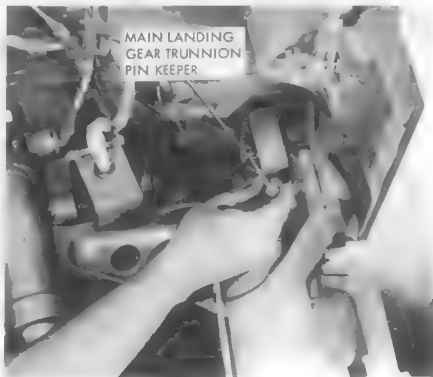
- 1** Exhaust hydraulic pressure.
- 2** Place airplane on jacks. (Refer to paragraph 1-14.)
- 3** Open landing gear doors. (Refer to paragraph 3-104.)
- 4** Remove wheel assembly. (Refer to paragraph 3-157.)
- 5** Disconnect and cap hydraulic line to brake assembly.
- 6** Remove nut, washer, composition roller bracket and bolt securing landing gear actuating cylinder rod end to landing gear post.
- 7** Remove cotter pin, nut, washer and bolt attaching trunnion fairing bungee to landing gear post.
- 8** Remove cotter pin, nut, washer and bolt securing landing gear downlock cylinder rod end to side brace linkage.
- 9** Remove cotter pins, nuts, washers and bolts securing the downlock switch actuating linkage to side brace link.
- 10** Disconnect the return spring from the downlock switch actuating link.
- 11** Remove downlock switch mounting bolts and position switch to allow clearance for removal of trunnion pins.
- 12** Remove ground safety switch from trailing link and disconnect wiring clamps (left main gear only).
- 13** Remove forward and aft trunnion pin keeper bolts.
- 14** Remove cotter pin, nut and washer attaching side brace to wing structure. (Use special tool T2644.)
- 15** Manually disengage downlock pin and partially fold side brace to separate side brace "T" bolt from attaching point.
- 16** Install 3/4-inch bolts in trunnion pins.
- 17** Support gear and remove forward and aft trunnion pins.
- 18** Remove main landing gear assembly from wheel well.

## INSTALLING

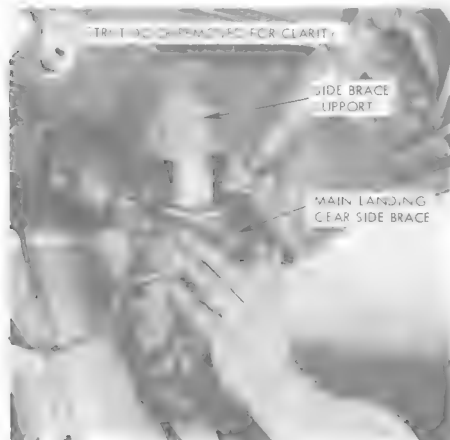
- 1** Position main landing gear assembly to fit on trunnion mounts and install forward and aft trunnion pins.



- 2** Secure trunnion pins with keeper bolts, washers, nuts and cotter pins.



- 3** Manually disengage downlock pin, fold side brace and install side brace "T" bolt through mounting support on wing structure.

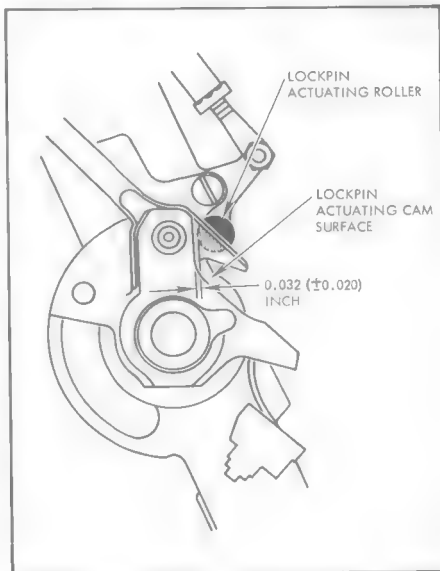
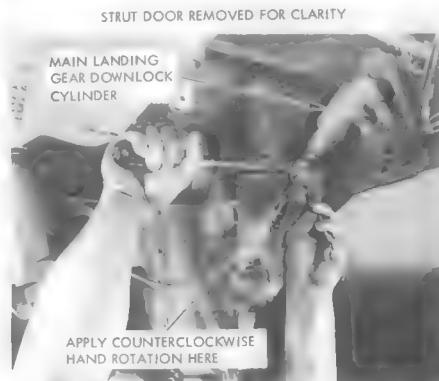


- 4** Install washer and nut on side brace "T" bolt and torque to 6000 inch-pounds. (Use special tool T2644.) Secure with cotter pin.

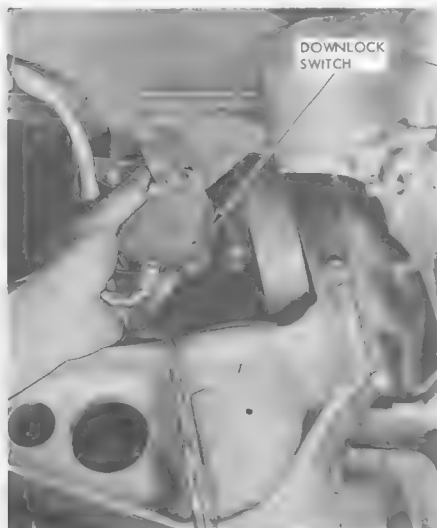


**Note** Side brace is bench adjusted but should be checked upon installation for correct dimensions. Adjust, if necessary, as outlined in paragraph 3-126. If side brace was disconnected from main landing gear post, refer to paragraph 3-126 for installation and adjustment.

- 5** While applying a counterclockwise hand rotation, adjust rod end of fully retracted downlock cylinder to obtain 0.032 ( $\pm 0.020$ ) inch clearance between lockpin actuating roller and cam surface on overcenter power arm.

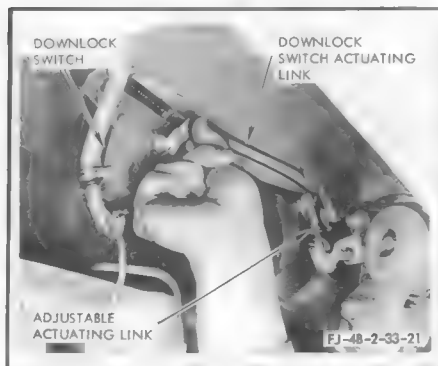


- 6** Install downlock switch on mounting bracket and secure with bolts, washers and nuts.

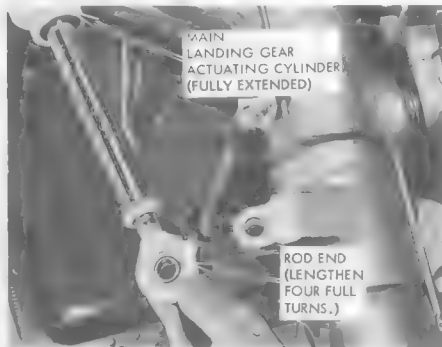


- 7** Connect downlock switch actuating link to switch arm and secure with pin, washer and cotter pin. Install return spring.

- 8** Install bolts, washers, nuts and cotter pin connecting downlock switch adjustable link to side brace link.



- 9** With the landing gear in down and locked position, adjust landing gear actuating cylinders extended length to fit between attaching points. Lengthen cylinder at rod end four full turns, tighten locknut and safety with lockwire (AN995F41).

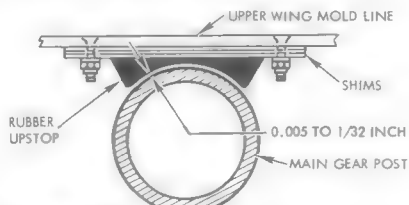


- 10** Secure cylinder rod end to main landing gear strut with bolt, composition roller, washer and nut.



- 11** Remove caps and connect brake pressure hydraulic line.

- 12** Retract gear to up and lock position, add or remove shims under rubber upstop to obtain 0.005 to 1/32-inch clearance between main gear post and upstop.

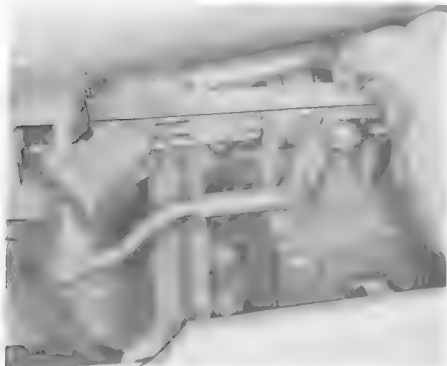


**Caution** Lower gear before adding or removing shims.

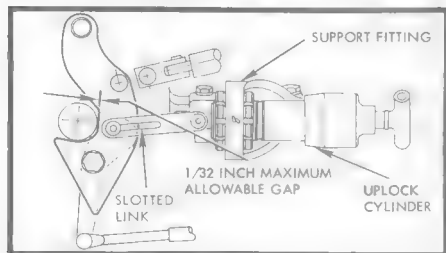
FJ-48-2-33-22

**Warning** Before accomplishing step 13 gear should be suitably supported in the retracted position to prevent it from falling and injuring personnel.

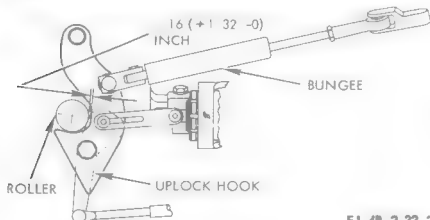
- 13** With the landing gear secured in the retracted position and the uplock bungee disconnected, adjust uplock cylinder on its support fitting to bottom the uplock hook against the uplock roller when the cylinder is fully extended and the hook is at the end of its slotted link.



**Note** Maximum allowable gap between hook and roller is 1/32 inch.



- 14** Manually position uplock hook to obtain 1/16 (+1/32/-0) inch clearance between hook and roller. Adjust uplock bungee extended length to fit and install.



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- 15** Install bolt, washer and nut attaching trunnion fairing door bungee to "q" bolt on gear post. Adjust bungee to fair door tight against door lands without distorting skin.



- 16** Adjust main landing gear uplock and downlock switches as outlined in steps 1 and 2 of paragraph 3-117.
- 17** Install wheel assembly. (Refer to paragraph 3-160.)
- 18** Bleed brake system. (Refer to paragraph 3-226.)
- 19** Check landing gear system. (Refer to paragraph 3-106.)
- 20** Check landing gear emergency extension system. (Refer to paragraph 3-196.)

**Note** During operational check of landing gear emergency extension system, check for 1/16-inch minimum sweepby clearance between main gear uplock roller and hook when an emergency extension is effected. To obtain clearance, properly rig landing gear emergency extension control system. (Refer to paragraph 3-199.)

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## 3-126. REMOVING, INSTALLING AND ADJUSTING MAIN LANDING GEAR SIDE BRACE.

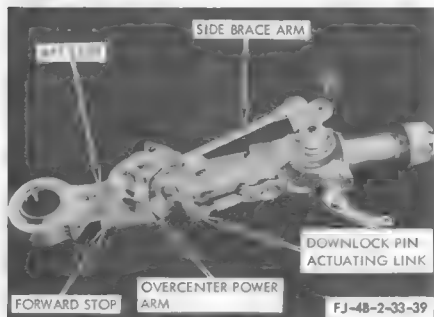


## REMOVING

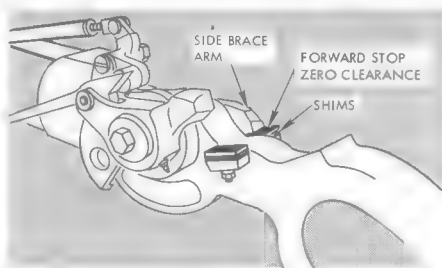
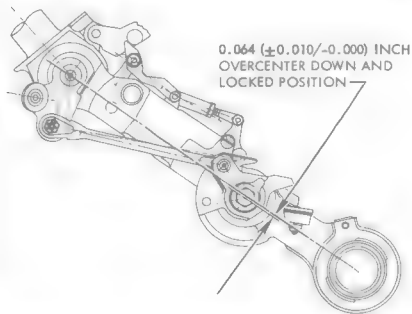
- 1** Place airplane on jacks. (Refer to paragraph 1-14.)
- 2** Remove cotter pin, nut, washer and bolt securing downlock cylinder rod end to side brace overcenter power arm linkage.
- 3** Remove cotter pin, nut, washer and bolt securing downlock switch actuating link to side brace.
- 4** Remove cotter pin, nut and washer securing side brace to wing support. (Use special tool T2844.)
- 5** Remove cotter pin, nut and washer securing side brace to main landing gear post.
- 6** Remove side brace from airplane.

## ADJUSTING

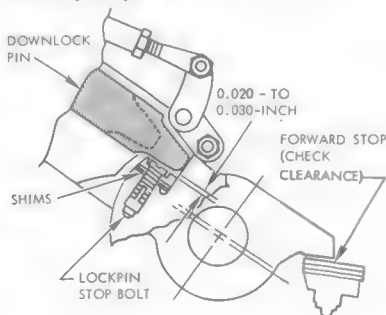
**Note** Side brace is bench adjusted but should be checked upon installation for correct dimensions and adjusted, if necessary, as outlined in the following instructions.



- 1** With side brace in locked position, check that it is 0.064 (+0.010/-0.000) inch overcenter with zero clearance between stop on forward side of brace and side brace arm. To obtain overcenter condition, add or remove shims as required under forward stop.

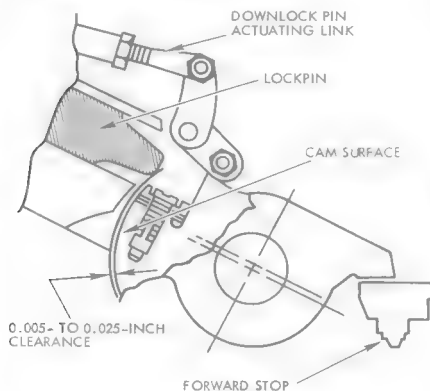


- 2** Check for 0.020- to 0.030-inch clearance between lockpin and lockpin stop. This clearance may be checked between forward stop and side brace arm with zero clearance between lockpin and lockpin stop bolt. To obtain this clearance, add or remove shims as required under lockpin stop bolt.

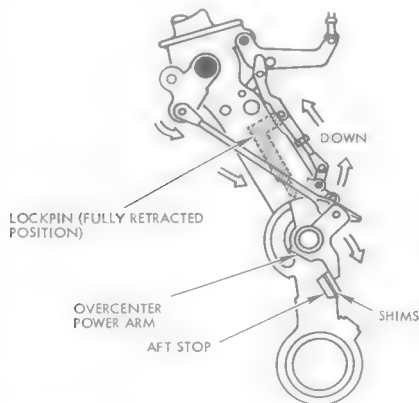


FJ-4B-2-33-40

- 3** Unlock and partially fold side brace. Check for a 0.005- to 0.025-inch clearance between cam surface and tip of retracted lockpin. To obtain this clearance, adjust downlock pin actuating link.



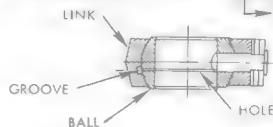
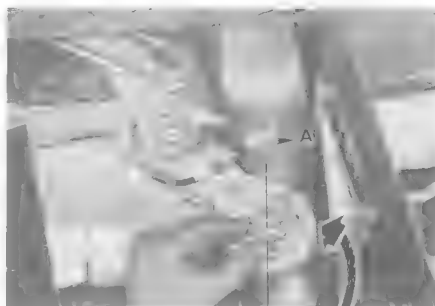
- 4** Check that overcenter power arm strikes stop on aft side of side brace at point where downlock pin reaches fully retracted position. Obtain this clearance by adding or removing shims as required under aft stop.



## INSTALLING

- 1** Position side brace to fit on attaching points between main gear post and wing support.
- 2** Install washer, nut and cotter pin securing lower link of side brace to main landing gear post.

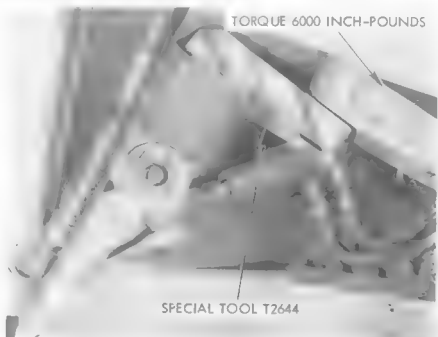
FJ-48-2-33-41



VIEW A-A

**Note** Make sure grease hole in pivoting ball is aligned with grease groove in side brace link before connecting to main gear post. If rotated 180 degrees, bearing surface of side brace lower link cannot be lubricated.

- 3** Install washer, nut and cotter pin securing upper link of side brace to wing support. Use special tool T2644 and torque nut to 6000 inch-pounds.



- 4** With main landing gear downlock switch properly adjusted (paragraph 3-117), install bolt, washer, nut and cotter pin securing downlock switch actuating link to side brace.

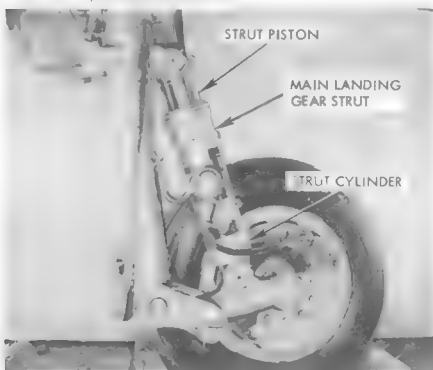
- 5** With main landing gear downlock cylinder properly adjusted (paragraph 3-136), install bolt, washer, nut and cotter pin securing downlock cylinder rod end to side brace overcenter power arm linkage.

- 6** Check landing gear system. (Refer to paragraph 3-106.)

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3-127. SERVICING MAIN LANDING GEAR STRUT.  
Refer to paragraph 1-43.

3-128. REMOVING AND INSTALLING MAIN  
LANDING GEAR STRUT.



### REMOVING

- 1 Deflate main landing gear strut. (Refer to paragraph 1-43.)
- 2 Place airplane on jacks. (Refer to paragraph 1-14.)
- 3 Remove main landing gear wheel. (Refer to paragraph 3-157.)
- 4 Remove clamp securing wheel brake system hydraulic line to strut.
- 5 Remove nut, washer and pin securing strut piston to main landing gear post.
- 6 Support strut and remove nut, washer and pin securing strut cylinder to main landing gear axle.
- 7 Remove strut from main landing gear axle assembly.

### INSTALLING

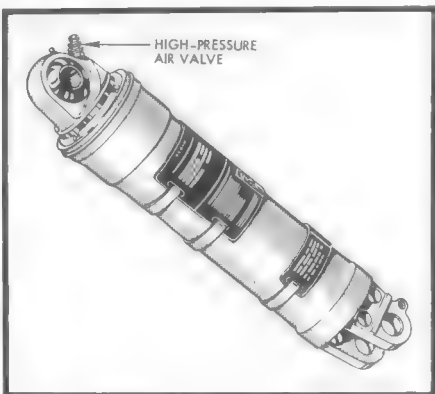
- 1 Position strut cylinder to fit on main landing gear axle assembly and secure with bolt, washer and nut.
- 2 Position strut piston to fit on main landing gear post and secure with bolt, washer and nut.
- 3 Install clamp securing wheel brake system hydraulic line to strut.
- 4 Remove jacks. (Refer to paragraph 1-43.)
- 5 Properly service and inflate main landing gear strut. (Refer to paragraph 1-14.)

3-129. DISASSEMBLING AND ASSEMBLING MAIN  
LANDING GEAR STRUT.

### DISASSEMBLING

**Warning** Make sure air pressure is released and that the strut is completely deflated before starting disassembly procedure.

- 1 Place strut assembly on a clean surface and remove the high-pressure air valve.
- 2 Remove bleeder plug and drain hydraulic fluid from the strut.
- 3 Remove lock ring securing gland nut to strut cylinder.
- 4 Using spanner wrench, remove gland nut from strut cylinder.



- 5 Secure strut cylinder and remove strut piston from cylinder.

**Note** When the strut piston is removed, the packing gland group will also be removed.

- 6 To disassemble strut piston, remove three pins securing piston head to piston.

**Note** To remove pins, insert a drift pin into hole 180 degrees from pin and force pins out.

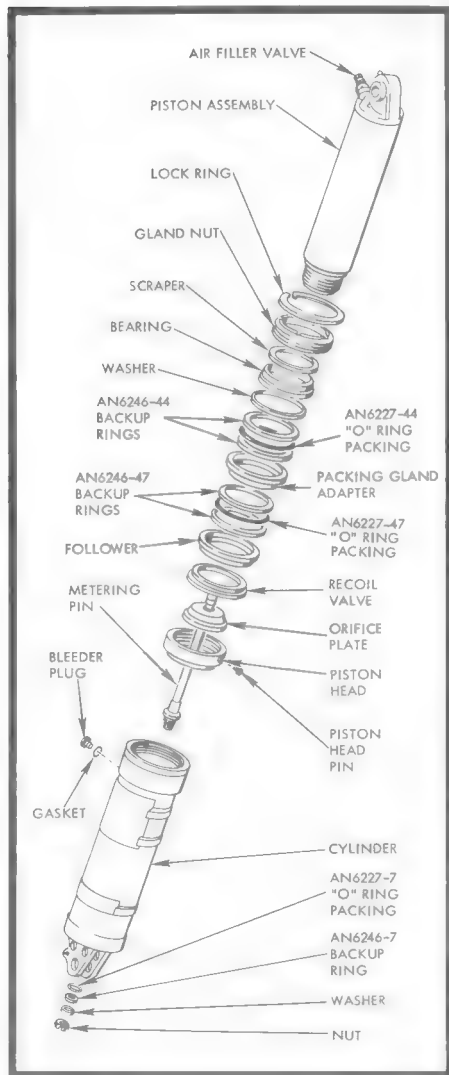
- 7 Using strap wrench, remove piston head from strut piston. Remove orifice plate from piston head.
- 8 Remove recoil valve from strut piston.
- 9 Slide packing gland follower, packing gland adapter, washer, bearing, scraper ring and gland nut from strut piston.

**Note** The packing gland adapter contains "O" ring packings and backup ring that may be replaced as necessary.

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FJ-48-2-33-33





**Note** Clean all metal parts with Stoddard Solvent (item 119, materials list) and thoroughly dry.

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**10** Remove cotter pin, nut and washer securing metering pin to the bottom of the strut cylinder.

**11** Remove metering pin from the cavity of the strut cylinder.

## ASSEMBLING

**Note** Prior to assembly, inspect all metal parts for cleanliness and condition; replace as required. Replace all "O" ring packings and backup rings.

TOLERANCE CHART FOR RECONDITIONING PISTON

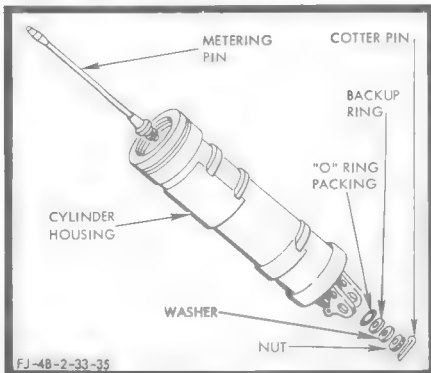
ORIGINAL DIAMETER OF BASIC METAL BEFORE PLATING	DIAMETER AFTER REPLATING AND FINISH GRINDING
$\frac{3.489}{3.487}$	$\frac{3.497}{3.495}$
RECONDITIONED MINIMUM DIAMETER AFTER GRINDING AND BEFORE PLATING	
3.487	

BEARING TOLERANCES CHART

NOMENCLATURE	NORMAL DIMENSION	REPLACE AT
PISTON HEAD	$\frac{3.872}{3.870}$ OD	3.862
BEARING	$\frac{3.500}{3.502}$ ID	3.509

**1** Install new "O" ring packing (AN6227-7) and backup ring (AN6246-7) in groove provided on metering pin.

**2** Insert the metering pin through the hole provided in the bottom of the strut cylinder housing and secure with washer, nut and cotter pin.

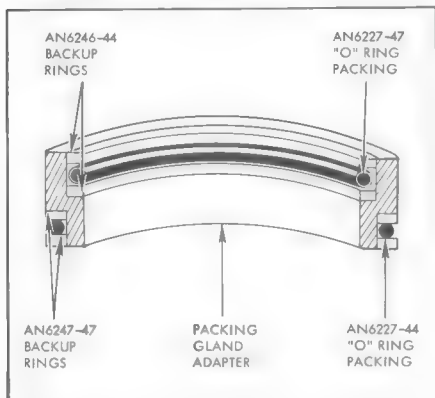


FJ-48-2-33-35

- 3** Place gland nut, scraper ring, bearing and washer on strut piston.

*Note* Lubricate bearing sparingly with a light coat of lubricant (item 82, materials list).

- 4** Assemble "O" ring packings and backup rings on packing gland adapter as shown.



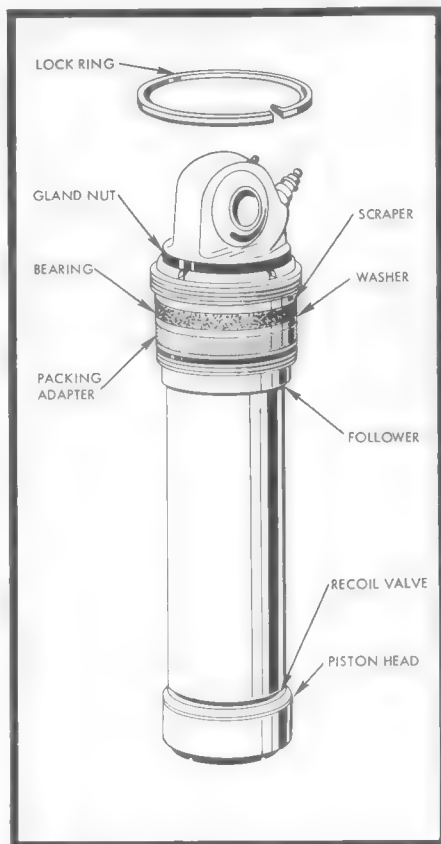
*Note* Lubricate packing gland adapter sparingly with a light coat of lubricant (item 82, materials list).

- 5** Place packing gland adapter and packing gland follower on piston and slide the complete packing gland group up to approximately the midway point on the strut piston.

*Note* Install the packing gland adapter over strut piston with the external "O" ring packing at the bottom.

- 6** Install the recoil valve over bottom of strut piston with the narrow side up.
- 7** Install the orifice plate in the piston head with the flat side down. Install piston head on the strut piston.
- 8** Install the three pins securing piston head to strut piston and stake into place.
- 9** Secure the strut cylinder in a vertical or horizontal position and insert the strut piston into the cavity of the strut cylinder until the packing gland group starts into the recess of the strut cylinder.

FJ-48-2-33-36



- 10** Apply a gentle force around entire circumference of the wiper ring until the packing gland group seats in the recess of the strut body sufficiently to start the gland nut.

- 11** Tighten gland nut and secure with lock ring.

- 12** Service strut with hydraulic fluid. (Refer to paragraph 1-43.)

- 13** Install bleeder plug and high pressure air valve in strut.

- 14** To test strut for leakage, inflate strut to 425 psi. (Refer to paragraph 1-43.) After one hour, strut should show no evidence of leakage. Deflate strut. (Refer to paragraph 1-43.)

FJ-48-2-33-37

**3-130. MAIN LANDING GEAR ACTUATING CYLINDER.** The main landing gear actuating cylinder retracts and extends the main landing gear assembly. The cylinder is a hydraulically operated unit rated at 3000 psi. The main landing gear actuating cylinder is located in the forward outboard corner of the main gear strut well. It is connected to the airplane structure by the trunnion end and to the landing gear post by the fitting at the rod end. The main landing gear actuating cylinder is a double acting, unbalanced-type unit. The piston rod can be varied in length by the adjustable fitting at the rod end.

**3-131. REMOVING AND INSTALLING MAIN LANDING GEAR ACTUATING CYLINDER.**



- 1** Place airplane on jacks. (Refer to paragraph 1-14.)
- 2** Exhaust hydraulic pressure.
- 3** Disconnect hydraulic lines from cylinder and cap openings.
- 4** Remove nut, washer, composition roller and bolt securing rod end of cylinder to gear post.
- 5** Support cylinder and remove split pin, nut, washer and bolt securing trunnion end of cylinder to wing structure.
- 6** Remove main gear actuating cylinder from strut well.

**INSTALLING**

- 1** Position trunnion end of main gear actuating cylinder to fit on mounting support in wing structure.
- 2** Install bolt, washer, nut and split pin securing trunnion end of cylinder to wing structure.
- 3** Fully extend actuating cylinder and adjust at rod end to fit at attaching point on gear post. Lengthen rod end four full turns. Safety locknut on rod end with AN995F41 lockwire.
- 4** Install bolt, composition roller, washer and nut securing cylinder rod end to main gear post.



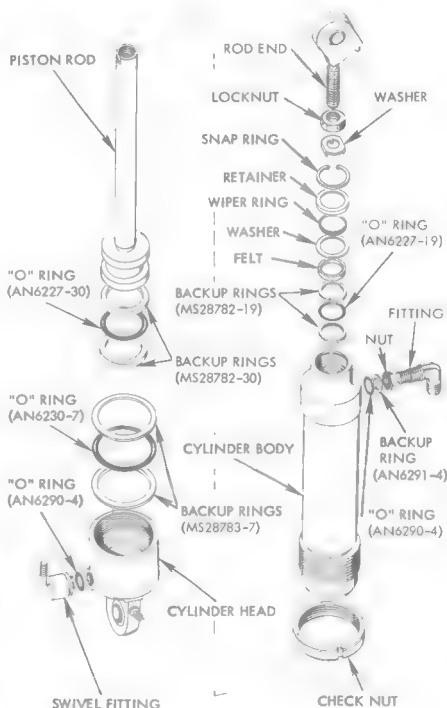
- 5** Remove caps and connect hydraulic lines to cylinder.
- 6** Check landing gear system. (Refer to paragraph 3-106.)

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**3-132. DISASSEMBLING AND ASSEMBLING MAIN LANDING GEAR ACTUATING CYLINDER.**

**DISASSEMBLING**

- 1** Secure actuating cylinder in holding device and remove hydraulic fittings from cylinder.
- 2** Loosen locknut securing rod end and remove rod end, lock washer and locknut from piston rod.
- 3** Remove snap ring, retainer, wiper ring, washer and felt from end of cylinder body.
- 4** Use spanner wrench to loosen check nut and remove cylinder head and check nut from cylinder body.
- 5** Remove piston rod from cylinder body.



**Note** Clean all metal parts with Stoddard Solvent (item 119, materials list).

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## ASSEMBLING

**Note** Prior to assembly, inspect all metal parts for cleanliness and condition; replace as required. Replace all "O" ring packings and backup rings. (Refer to General Information, Section III.)

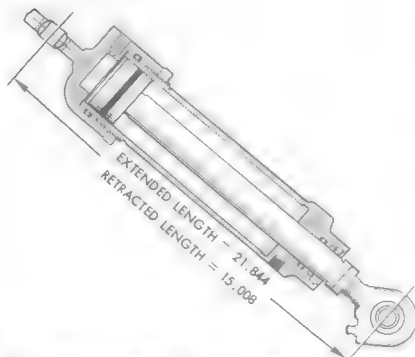
BEARING TOLERANCE CHART		
NOMENCLATURE	NORMAL DIMENSION	REPLACE AT
CYLINDER BODY ID	$\frac{2.125}{2.127}$	2.129
CYLINDER BORE ID (PISTON ROD BEARING SURFACE)	$\frac{1.001}{1.002}$	1.004
PISTON HEAD OD	$\frac{2.120}{2.121}$	2.119
PISTON ROD OD	$\frac{0.996}{0.997}$	0.995

- 1 Assemble cylinder in reverse sequence of disassembly procedure.

**Note** When installing the cylinder head, do not use head to adjust cylinder stroke. Install head until bottomed on cylinder body and back off not more than one turn to align port. Adjust cylinder stroke at rod end.

- 2 After assembly is completed, check cylinder break-out friction by hand. Break-out friction shall not exceed 40 pounds. Piston must move in and out freely.

- 3 To proof test cylinder, apply 4500 psi for two minutes, first to one port and then the other, with piston bottomed at the opposite end and the opposite port open. There shall be no external or internal leakage or damage to the cylinder.

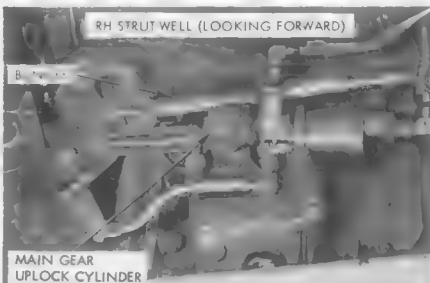


- 4 To test cylinder for external leakage, operate cylinder through five complete cycles at 3000 psi. Leakage around piston rod shall not exceed one drop in 25 cycles.

FJ-48-2-33-51

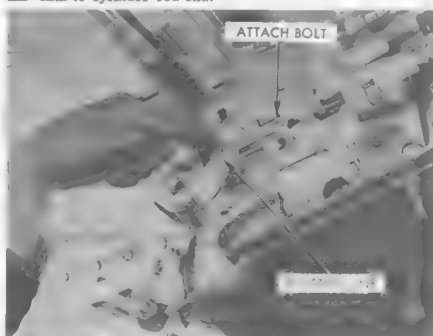
3-133. MAIN LANDING GEAR UPLOCK CYLINDER. The main landing gear uplock cylinder actuates the main gear uplock hook mechanism to the unlocked position. The uplock cylinder is connected to the uplock hook by a pin and slotted link which allows the gear to engage the hook mechanically with the uplock cylinder pressurized. Bungee action closes the hook. The uplock cylinder is mounted in a support fitting located along the forward wing structure in the gear strut well. The uplock cylinder is a double acting, unbalanced-type cylinder, rated at 3000 psi. Adjustment of the uplock cylinder is made by screwing the complete cylinder body in or out on its support fitting.

## 3-134. REMOVING AND INSTALLING MAIN LANDING GEAR UPLOCK CYLINDER.



## REMOVING

- 1 Open landing gear doors. (Refer to paragraph 3-104.)
- 2 Disconnect three hydraulic lines from main gear uplock cylinder and cap openings.
- 3 Remove cotter pin, washer and pin attaching slotted link to cylinder rod end.



- 4 Using suitable tools, break safety wire and remove inboard check nut attaching uplock cylinder to support fitting.
- 5 Remove cylinder from strut well.

FJ-48-2-33-45

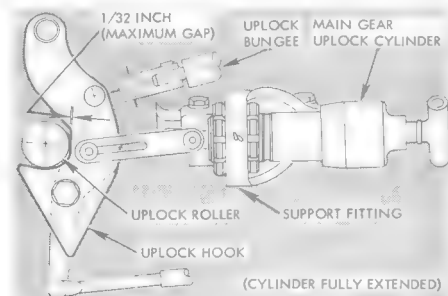
## INSTALLING

- 1** Position uplock cylinder through its support fitting and secure with inboard check nut.



- 2** Connect slotted link to cylinder rod end and secure with pin, washer and cotter pin.
- 3** Remove caps and connect the three hydraulic lines to uplock cylinder.
- 4** Adjust the uplock cylinder in its support fitting to bottom the landing gear uplock hook against the uplock roller when the cylinder is fully extended and the hook is at the end of the slotted link. Maximum gap permitted between hook and roller is 1/32 inch.

**Note** Disconnect bungee from uplock hook before making this adjustment.



- 5** Tighten uplock cylinder check nuts and safety with AN995F41 lockwire.
- 6** Check landing gear system. (Refer to paragraph 3-106.)

FJ-48-2-33-46

**3-135. MAIN LANDING GEAR DOWNLOCK CYLINDER.** The main landing gear downlock cylinder withdraws the downlock pin from the side brace sections and pulls the side brace from its overcenter condition when the main gears are to be retracted. The downlock cylinder does not function during the extending cycle. The downlock cylinder is located along the aft wing structure in the main gear wheel well and is attached at its trunnion end to the wing structure and at its rod end to the overcenter power arm linkage of the side brace. The downlock cylinder is a double acting, spring-loaded, unbalanced-type cylinder, rated at 3000 psi. It is spring-loaded to the retract position. The downlock cylinder's piston rod can be varied in length by the adjustable rod end.

## 3-136. REMOVING AND INSTALLING MAIN LANDING GEAR DOWNLOCK CYLINDER.

### REMOVING

- 1** Exhaust hydraulic pressure.
- 2** Open landing gear fairing doors. (Refer to paragraph 3-104.)
- 3** Disconnect two hydraulic lines from downlock cylinder and cap openings.
- 4** Remove cotter pin, nut, washer and bolt securing rod end of cylinder to side brace linkage.
- 5** Support cylinder and remove cotter pin, nuts, washer and bolt securing trunnion end of cylinder to structure.
- 6** Remove downlock cylinder from strut well.

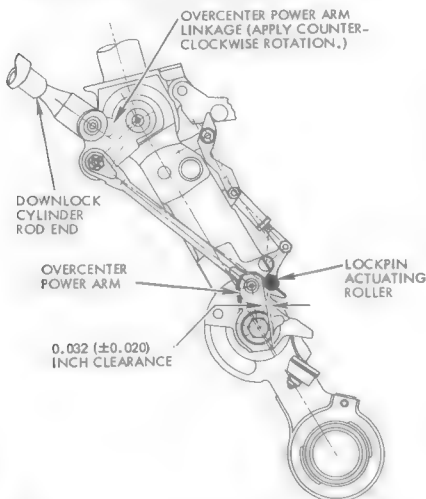


### INSTALLING

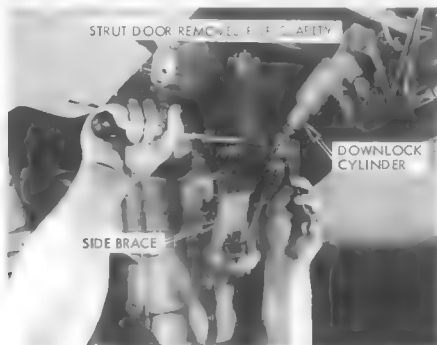
- 1** Position trunnion end of cylinder to fit on mounting support and secure with bolt, washer, nut and cotter pin.

FJ-48-2-33-58

- 2** While applying a counterclockwise rotation to the overcenter power arm linkage (to reduce play), adjust the rod end of the fully retracted downlock cylinder out to obtain 0.032 ( $\pm 0.020$ ) inch clearance between lockpin actuating roller and roller cam surface on the overcenter power arm. Secure locknut on cylinder rod end and safety with AN995F41 lockwire.



- 3** Install bolt, washers, nut and cotter pin securing cylinder rod end to overcenter power arm linkage.



- 4** Remove caps and connect two hydraulic lines to cylinder.
- 5** Check landing gear system. (Refer to paragraph 3-106.)

FJ-48-2-33-59

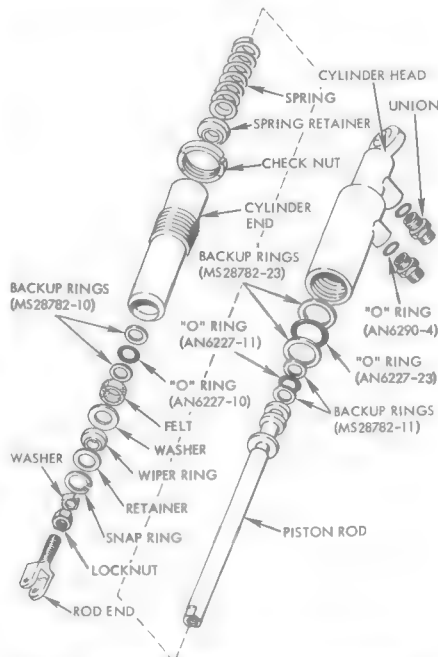
### 3-137. DISASSEMBLING AND ASSEMBLING MAIN LANDING GEAR DOWNLOCK CYLINDER.

#### DISASSEMBLING

- 1** Secure actuating cylinder in a holding device and remove hydraulic fittings.
- 2** Loosen locknut securing rod end and remove rod end, washer and locknut from piston rod.
- 3** Remove snap ring, retainer, wiper ring, washer and felt from cylinder end.

**Warning** Care must be exercised when accomplishing step 4. Cylinder contains spring that can eject the cylinder apart with sufficient force to injure personnel.

- 4** Loosen check nut and remove cylinder head, spring retainer, spring and check nut from cylinder end.
- 5** Remove piston rod from cylinder head.



**Note** Clean all metal parts in Stoddard Solvent (item 119, materials list) and thoroughly dry.

FJ-48-2-33-52

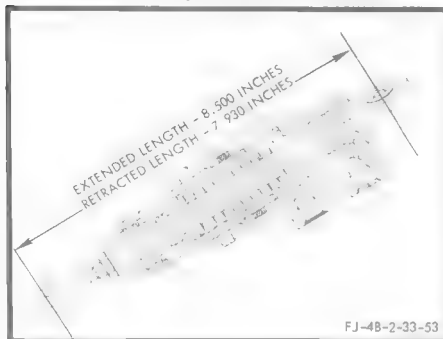
## ASSEMBLING

**Note** Prior to assembly, inspect all metal parts for cleanliness and condition; replace as required. Replace all "O" ring packings and backup rings. (Refer to General Information, Section III.)

BEARING TOLERANCES CHART		
NOMENCLATURE	NORMAL DIMENSION	REPLACE AT
CYLINDER HEAD ID	0.749	
(PISTON HEAD BEARING SURFACE)	0.751	0.753
CYLINDER END ID	0.50	
(PISTON ROD BEARING SURFACE)	0.502	0.504
PISTON HEAD OD	0.746	
	0.747	0.745
PISTON ROD OD	0.497	
	0.498	0.496

**1** Assemble cylinder in reverse sequence of disassembly procedure.

**Note** When installing the cylinder end, do not use end to adjust cylinder stroke. Install end until bottomed on cylinder head and back off not more than one-half turn. Adjust cylinder stroke at rod end.



**2** After assembly is completed, proof test cylinder by applying 4500 psi for two minutes, first to one port and then the other, with piston bottomed at the opposite end and the opposite port open. There shall be no internal or external leakage or damage to the cylinder.

**3** To test cylinder for external leakage, operate cylinder through five complete cycles at 3000 psi. Leakage around piston rod shall not exceed one drop in twenty-five cycles.

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**3-138. MAIN LANDING GEAR FAIRING DOORS.** When in the retracted position, the main landing gear assemblies are completely faired within the airplane's outer surface. Each main gear is faired by a strut door, a wheel door and a trunnion fairing. (See figure 3-39.) The strut and wheel doors are hydraulically operated in sequence with the landing gears. The trunnion fairing is linked to the main gear post by mechanical linkage and follows the movement of the gears. Emergency provisions are incorporated to unlock the doors mechanically in the event of electrical or hydraulic failure.

**3-139. MAIN LANDING GEAR WHEEL DOOR.** The main landing gear wheel doors fair the main landing gear wheel wells. The doors are hinged at the lower centerline of the fuselage to a structural member by a piano-type hinge (figure 3-39). The doors are hydraulically operated. Each door is locked in the closed position by an overcenter-type locking mechanism located along the aft wing structure in the wheel well. The locking mechanism is actuated by the door lock cylinder. The landing gear emergency extension cable is connected to the locking mechanism to provide a means for manually releasing the door lock hooks. The door lock rollers can be adjusted up or down on a serrated plate to fair the door to the airplane's mold line.

## 3-140. REMOVING, INSTALLING AND ADJUSTING MAIN LANDING GEAR WHEEL DOOR.



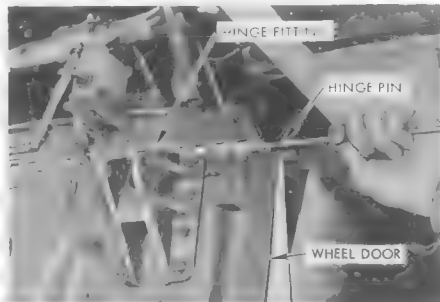
## REMOVING

- 1** Open doors. (Refer to paragraph 3-104.)
- 2** Lower center fuselage engine access door.
- 3** Remove cotter pin, nut, washer and bolt attaching door actuating cylinder to door.
- 4** Disconnect bonding wire from door.
- 5** Remove cotter pin, washer and pin attaching door open switch actuating linkage to door.
- 6** Remove composition fuel line clamp from hinge fitting.
- 7** Remove bolts, washers and nuts attaching hinge fitting to support.
- 8** Lower hinge fitting far enough to permit wheel door hinge pin removal.
- 9** Grasp hinge pin at the forward end of wheel door; support door and remove hinge pin.
- 10** Remove wheel door from airplane.

FJ-48-2-33-26

## INSTALLING AND ADJUSTING

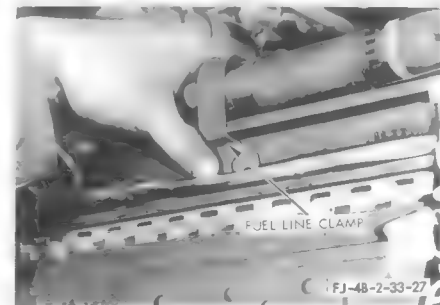
- 1** Position door to fit on hinge fitting and install hinge pin.



- 2** Lift hinge fitting into position and install bolts, washers and nuts securing hinge fitting to fuselage structure.



- 3** Install composition fuel line clamp.

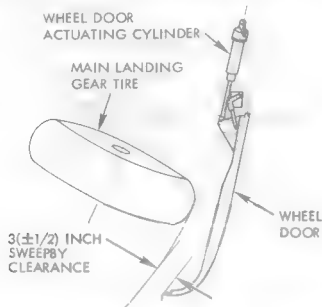




### Section III Landing Gear System

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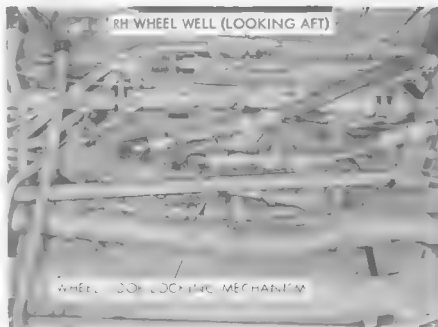
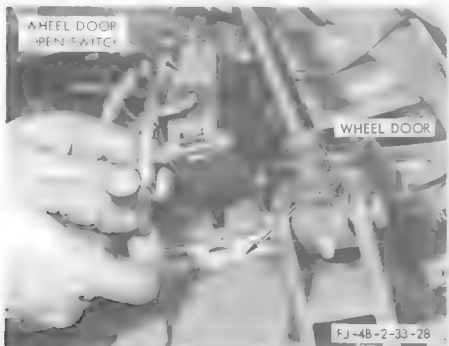
- 4** Adjust extended length of the wheel door actuating cylinder to permit a  $3 (\pm 1/2)$  inch sweepby clearance between main landing gear tire and wheel door. Tighten rod end locknut and safety with AN995F32 lockwire.



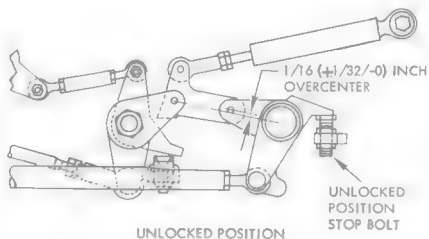
- 5** Install bolt, washers, nut and cotter pin securing cylinder rod end and universal joint to bracket.



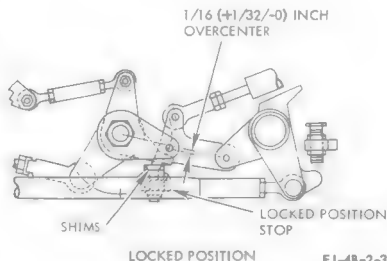
- 6** Install pin, washer and cotter pin attaching door open switch linkage to door.



- 7** With the wheel door locking mechanism in the unlocked position, adjust unlocked position stop bolt to obtain a  $1/16 (+1/32/-0)$  inch overcenter condition of the locking mechanism.

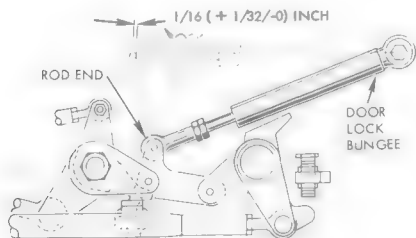


- 8** With the wheel door locking mechanism in the locked position, use shims, as required, under the locked position stop to obtain a  $1/16 (+1/32/-0)$  inch overcenter condition of the locking mechanism.

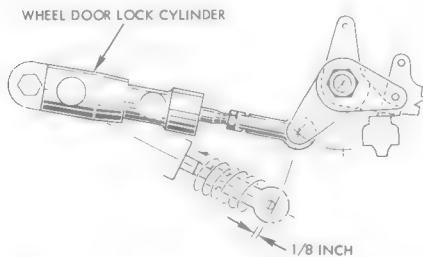


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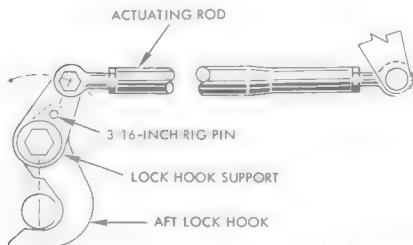
- 9** With the wheel door locking mechanism in the locked position, adjust free length of bungee to fit between attaching points. Lengthen rod end of bungee  $1/16$  ( $\pm 1/32$ )-0 inch and install.



- 10** With the wheel door locking mechanism in the locked position, fully compress wheel door lock cylinder and adjust at rod end to fit between attaching points. Shorten rod end of lock cylinder  $1/8$  inch and install.

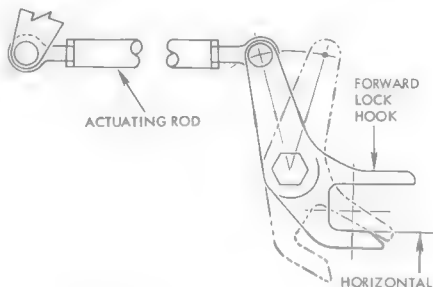


- 11** With the wheel door locking mechanism in the locked position, insert a rig pin through the aft lock hook and the hook support. Adjust aft lock hook actuating rod to fit between attaching points and install.



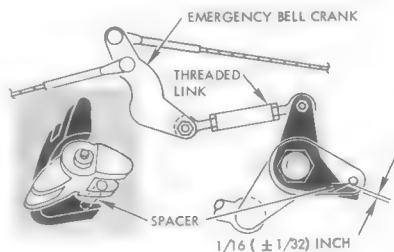
FJ-4B-2-33-30

- 12** Adjust forward lock hook actuating rod to position the lower leg of the lock hook in a horizontal position and install.

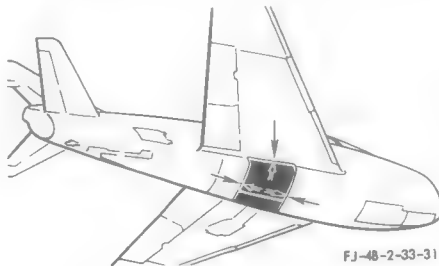


- 13** Remove rig pins.

- 14** Adjust threaded link between emergency bell crank and door lock mechanism to obtain  $1/16$  ( $\pm 1/32$ ) inch between locking mechanism spacer and emergency release arm.

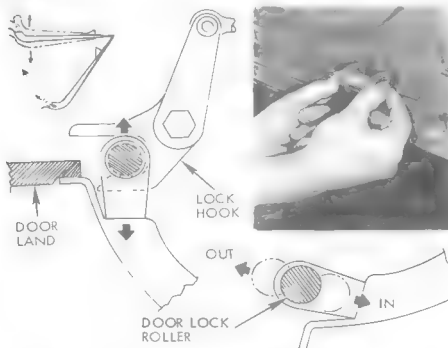


- 15** Trim wheel door as required to fit flush against lands.

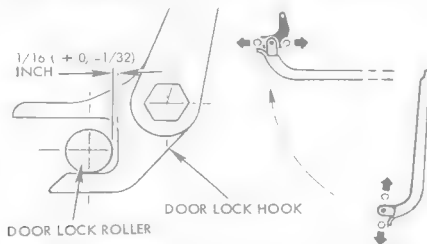


FJ-4B-2-33-31

- 16** Adjust forward and aft door lock rollers in, or out, on their serrations to rig door tight against door lands without distorting outer skin when door is closed and locked.



- 17** Adjust forward and aft door lock rollers up, or down, on their serrations to obtain  $1/16$  (+0/-1/32) inch clearance between door lock rollers and lock hooks when door is closed and locked.



- 18** Properly adjust wheel door open, closed and locked switches as outlined in steps 5, 6 and 7 of paragraph 3-117.

- 19** Check landing gear system. (Refer to paragraph 3-106.)

- 20** Check landing gear emergency extension system. (Refer to paragraph 3-198.)

FJ-48-2-33-32

**3-141. MAIN LANDING GEAR WHEEL DOOR ACTUATING CYLINDER.** The main landing gear wheel door actuating cylinder opens and closes the wheel doors. Each door has a separate cylinder. The wheel door actuating cylinder is located in the forward inboard corner of the wheel well. It is connected to the airplane structure by the trunnion end of the cylinder and to the forward structure of the door by a clevis fitting and a universal joint at the rod end. The cylinder is a double acting, unbalanced-type unit, rated at 3000 psi. The piston rod can be varied in length by adjusting the clevis fitting at the rod end of the cylinder.

### 3-142. REMOVING AND INSTALLING MAIN LANDING GEAR WHEEL DOOR ACTUATING CYLINDER.

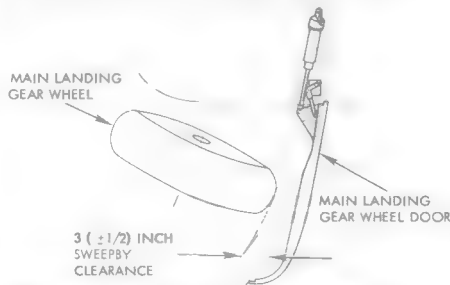


#### REMOVING

- 1** Exhaust utility system hydraulic pressure.
- 2** Open landing gear doors. (Refer to paragraph 3-104.)
- 3** Disconnect two hydraulic lines from actuating cylinder and cap openings.
- 4** Remove cotter pin, nut, washers and bolt attaching universal joint and rod end of cylinder to wheel door.
- 5** Support cylinder and remove nut, washer and bolt attaching trunnion end of cylinder to support fitting.
- 6** Remove cylinder from wheel well.

#### INSTALLING

- 1** Position trunnion end of cylinder to fit on support fitting and secure with bolt, washer and nut.
- 2** Remove caps and connect two hydraulic lines to cylinder.
- 3** Adjust rod end of actuating cylinder to obtain a  $3 (\pm 1/2)$  inch sweepby clearance between main gear wheel and door when door is full open. Tighten rod end locknut and safety with AN995F32 lockwire.



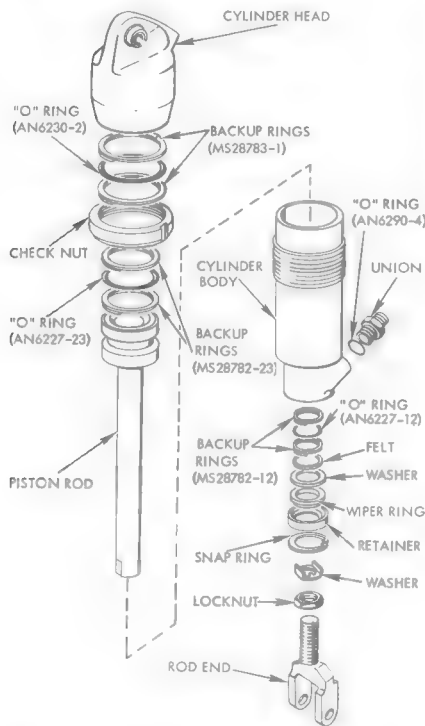
- 4** Connect universal joint and rod end of cylinder to door and secure with bolt, washer, nut and cotter pin.
- 5** Check landing gear system. (Refer to paragraph 3-106.)

FJ-48-2-33-48

3-143. DISASSEMBLING AND ASSEMBLING MAIN  
LANDING GEAR WHEEL DOOR ACTUATING  
CYLINDER.

## DISASSEMBLING

- 1** Secure actuating cylinder in holding device and remove hydraulic fittings from cylinder.
- 2** Loosen locknut securing rod end and remove rod end, lock washer and locknut from piston rod.
- 3** Remove snap ring, retainer, wiper ring, washer and felt from end of cylinder body.
- 4** Use spanner wrench to loosen check nut and remove cylinder head and check nut from cylinder body.
- 5** Remove piston rod from cylinder body.



**Note** Clean all metal parts with Stoddard Solvent (item 119, materials list).

FJ-48-2-33-54

## ASSEMBLING

**Note** Prior to assembly, inspect all metal parts for cleanliness and condition; replace as required. Replace all "O" ring packings and backup rings. (Refer to General Information, Section III.)

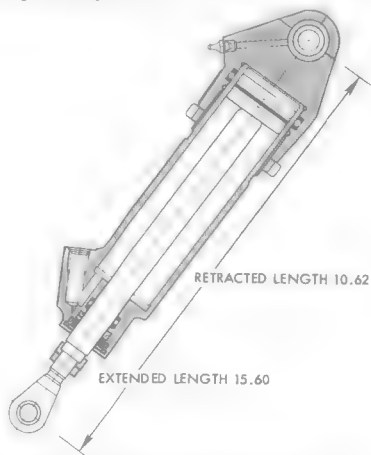
BEARING TOLERANCE CHART		
NOMENCLATURE	NORMAL DIMENSION	REPLACE AT
CYLINDER BODY ID	1.500	1.503
	1.502	
CYLINDER BORE ID (PISTON ROD BEARING SURFACE)	0.626	0.629
	0.627	
PISTON HEAD OD	1.496	1.495
	1.497	
PISTON ROD OD	0.622	0.621
	0.623	

- 1** Assemble cylinder in reverse sequence of disassembly procedure.

**Note** When installing the cylinder head, do not use head to adjust cylinder stroke. Install head until bottomed on cylinder body and back off not more than one turn to align ports. Adjust cylinder stroke at rod end.

- 2** After assembly is complete, check cylinder breakout friction by hand. Breakout friction shall not exceed 40 pounds. Piston must move in and out freely.

- 3** To proof test cylinder, apply 4500 psi for two minutes, first to one port and then the other, with the piston bottomed at the opposite end and the opposite port open. There shall be no external or internal leakage or damage to the cylinder.



- 4** To test cylinder for external leakage, operate cylinder through five complete cycles at 3000 psi. Leakage around piston rod shall not exceed one drop in 25 cycles.

FJ-48-2-33-55

3-144. MAIN LANDING GEAR WHEEL DOOR LOCK ACTUATING CYLINDER. The main landing gear wheel door lock actuating cylinder operates the wheel door locking mechanism. It is located on the aft wing structure in the main gear wheel well and is connected to the wing structure at the trunnion end of the

cylinder and to the actuating arm of the locking mechanism at the rod end. The cylinder is a double acting, unbalanced-type unit, rated at 3000 psi. The piston rod length can be varied by adjusting the rod end of the cylinder.

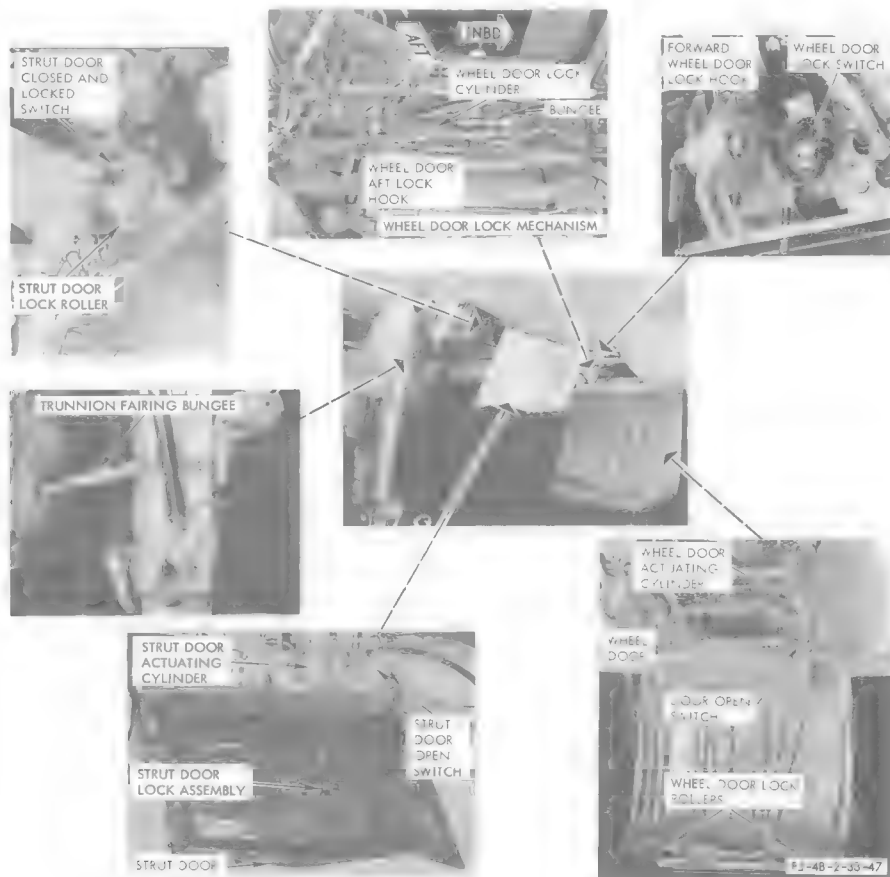
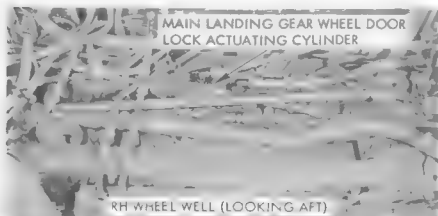


Figure No. 3-39. Main Landing Gear Fairing Doors

## 3-145. REMOVING AND INSTALLING MAIN LANDING GEAR WHEEL DOOR LOCK ACTUATING CYLINDER.

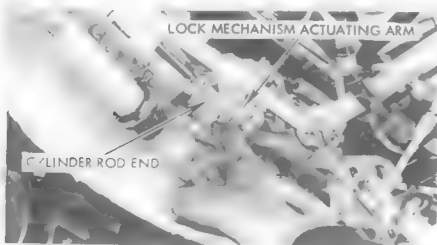


## REMOVING

- 1 Open doors. (Refer to paragraph 3-104.)
- 2 Exhaust hydraulic pressure.
- 3 Disconnect two hydraulic lines from door lock cylinder and cap openings.
- 4 Remove cotter pin, nut, washer and bolt securing rod end of cylinder to lock mechanism actuating arm.
- 5 Support lock cylinder and remove nut, washers and bolt securing trunnion end of cylinder to wing structure.
- 6 Remove cylinder from wheel well.

## INSTALLING

- 1 Position trunnion end of cylinder to fit on its structural mounting and secure with bolt, washers and nut.
- 2 Manually actuate lock mechanism to the locked position.
- 3 Fully retract lock cylinder and adjust at rod end to fit at attaching point on lock mechanism actuating arm.
- 4 Shorten rod end 1/8 inch and secure to actuating arm with bolt, washer, nut and cotter pin. Safety locknut on rod end.



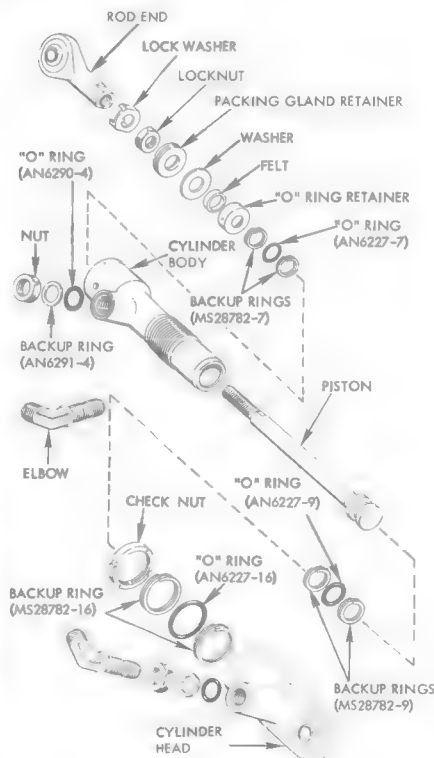
- 5 Remove caps and connect hydraulic lines to lock cylinder.
- 6 Check landing gear system. (Refer to paragraph 3-106.)

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## 3-146. DISASSEMBLING AND ASSEMBLING MAIN LANDING GEAR WHEEL DOOR LOCK ACTUATING CYLINDER.

## DISASSEMBLING

- 1 Secure actuating cylinder in holding device and remove hydraulic fittings from cylinder.
- 2 Loosen locknut securing rod end and remove rod end, lock washer and locknut from piston rod.
- 3 Remove packing gland retainer, washer, felt and "O" ring retainer from end of cylinder body.
- 4 Use spanner wrench to loosen check nut and remove cylinder head and check nut from cylinder body.
- 5 Remove piston rod from cylinder body.



**Note** Clean all metal parts with Stoddard Solvent (item 119, materials list).

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## ASSEMBLING

**Note** Prior to assembly, inspect all metal parts for cleanliness and condition; replace as required. Replace all "O" ring packings and backup rings. (Refer to General Information, Section III.)

BEARING TOLERANCES CHART

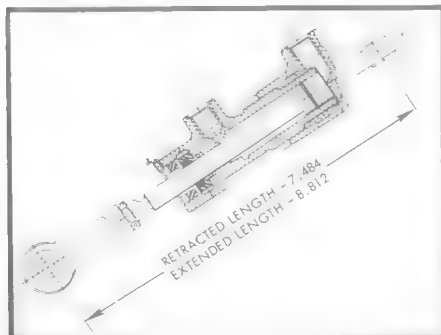
NOMENCLATURE	NORMAL DIMENSION	REPLACE AT
CYLINDER BODY ID	0.624 0.626	0.627
CYLINDER BORE ID (PISTON ROD BEARING SURFACE)	0.376 0.377	0.378
PISTON HEAD OD	0.621 0.622	0.620
PISTON ROD OD	0.372 0.373	0.371

- 1 Assemble cylinder in reverse sequence of disassembly procedure.

**Note** When installing the cylinder head, do not use head to adjust cylinder stroke. Install head until bottomed on cylinder body and back off not more than one turn to align ports. Adjust cylinder stroke at rod end.

- 2 After assembly is complete, check cylinder breakout friction by hand. Breakout friction shall not exceed 40 pounds. Piston must move in and out smoothly.

- 3 To proof test cylinder, apply 4500 psi for two minutes, first to one port and then the other, with the piston bottomed at the opposite end and the opposite port open. There shall be no external or internal leakage or damage to the cylinder.



- 4 To test cylinder for external leakage, operate cylinder through five complete cycles at 3000 psi. Leakage around piston rod shall not exceed one drop in 25 cycles.

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3-147. MAIN LANDING GEAR STRUT DOOR. The main landing gear strut door fairs the main landing gear strut well. The strut door is mounted to the forward edge of the strut well by two hinges. An overcenter-type locking mechanism is installed within the strut door to lock it in the closed position. The strut door is actuated and locked by a single hydraulic actuating cylinder. The strut door's lock roller is located along the aft wing structure in the strut well and can be adjusted up or down on a serrated plate to fair the strut door to the airplane's mold line. Emergency release of the strut door is effected by the falling main gear post contacting the bell crank on the strut door lock mechanism and unlocking the hook to permit the door to open.

3-148. REMOVING, INSTALLING AND ADJUSTING MAIN LANDING GEAR STRUT DOOR.



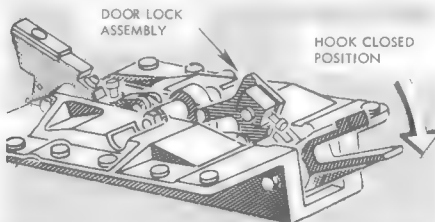
## REMOVING

- 1 Open landing gear doors. (Refer to paragraph 3-104.)
- 2 Remove nut, washer, bolt and spacer securing door open switch linkage to strut door.
- 3 To gain access for disconnecting the actuating cylinder from the door linkage, remove nut, washers and bolt joining lock actuating lever to lock assembly.
- 4 Remove snap ring, washer and pin attaching actuating cylinder to lock actuating lever.
- 5 Disconnect bonding wire from door.
- 6 Remove nuts, washers and bolts attaching inboard and outboard door hinge to hinge fitting on wing structure.
- 7 Remove door from airplane.

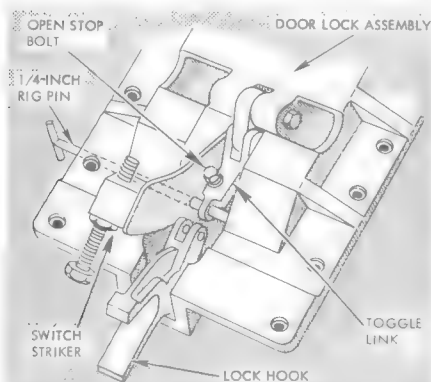
FJ-4B-2-33-91

## INSTALLING

- 1** Prior to installing strut door, remove 13 bolts and three screws securing door lock assembly to strut door and remove lock assembly from door.

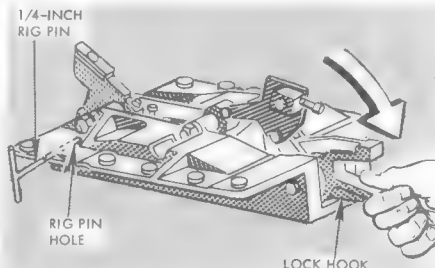


- 2** Pull actuating lever of lock hook to closed position and remove cotter pin, washer and pin joining toggle link and switch striker to lock hook.
- 3** Pull actuating lever into open position. Insert 1/4-inch rig pin through lock assembly housing and the lock hook attaching point on the toggle link.
- 4** Adjust door lock mechanism open stop bolt until flush against stop. Tighten locknut and safety with AN995F32 lockwire. Remove rig pin.



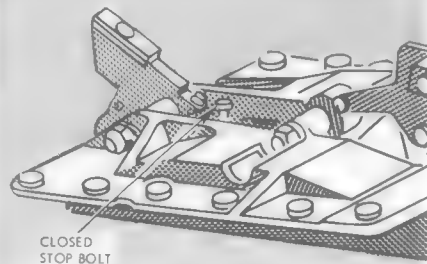
- 5** Pull actuating lever to closed position. Install pin, washer and cotter pin to join toggle link and striker to lock hook.

- 6** Insert 1/4-inch rig pin through lock mechanism housing and cylinder attaching point of actuating lever. Position door lock assembly to the locked position.



**Warning** A considerable amount of bungee tension must be overcome when accomplishing step 6. Locking assembly should be secured and personnel's fingers kept clear.

- 7** Adjust door lock mechanism closed stop bolt until flush against stop. Tighten locknut and safety with AN995F32 lockwire.



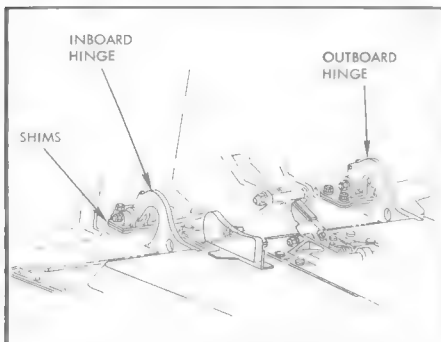
- 8** To unlock lock assembly, insert drift pin in hole provided and push directly up. Remove rig pin.
- 9** Install lock mechanism on strut door and secure with 13 bolts and three screws.



**Section III**  
**Landing Gear System**

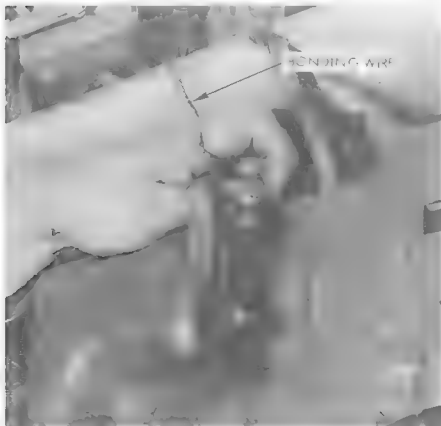
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- 10** Position strut door to fit on inboard and outboard hinge support fitting and install bronze bushings, bolts, washers and nuts securing hinges to support fittings.

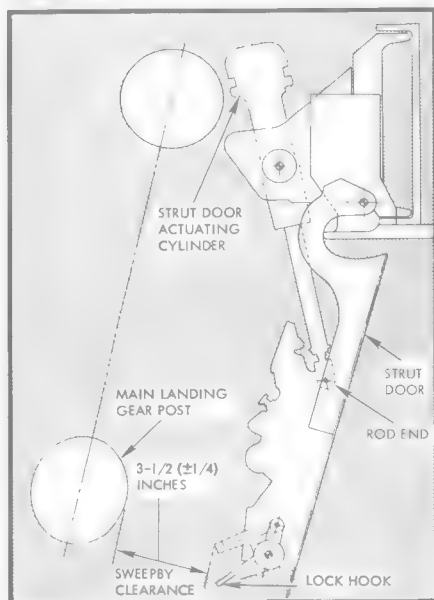


**Note** Use shims as required under inboard and outboard hinge support fittings to fair forward edge of strut door to the wing mold line.

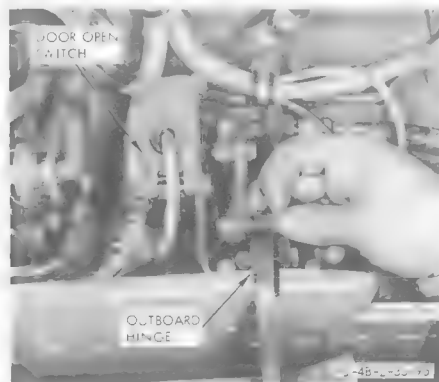
- 11** Connect bonding wire to door.



- 12** With the strut door actuating cylinder fully extended, adjust the cylinder rod end to allow 3-1/2 (± 1/4) inch sweepby clearance between main landing gear post and door lock hook. Secure actuating cylinder to lock actuating lever of assembly. Tighten locknut and safety with AN995F32 lockwire.

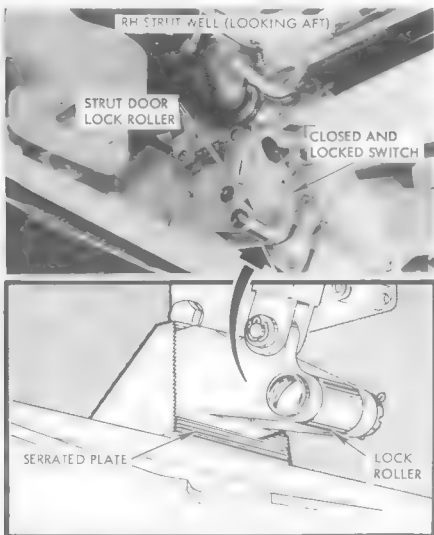


- 13** Install bolt, spacer, washers and nut securing door open switch linkage to outboard door hinge.

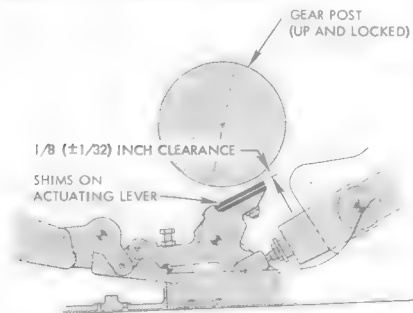


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- 14** Adjust door lock roller up or down on its serrated plate to rig aft end of strut door against the door land without distorting outer skin.



- 15** Remove lamination from laminated shims to obtain  $1/8$  ( $\pm 1/32$ ) inch clearance between door lock assembly actuating lever and gear post when gear is up and locked and door is closed and locked.



- 16** Properly adjust strut door open and door closed and locked switches as outlined in steps 3 and 4 of paragraph 3-117.
- 17** Check operation of landing gear normal and emergency extension system. (Refer to paragraphs 3-106 and 3-198.)

FJ-48-2-33-96A

**3-149. MAIN LANDING GEAR STRUT DOOR ACTUATING CYLINDER.** The main landing gear strut door actuating cylinder operates the strut door and its locking mechanism. The cylinder is mounted in a fitting on the wing structure along the forward edge of the strut well. During operation, the cylinder body is pivoted approximately 60 degrees on two bearings in its support fitting. Hydraulic pressure to retract and extend the cylinder is routed through swivel joints within the bearings. A drilled passage within the cylinder body directs pressure to extend the cylinder and provides a path for return fluid when the cylinder is retracting. The strut door cylinder is a double acting type cylinder, rated at 3000 psi. Piston rod length of the cylinder can be varied by adjusting the clevis fitting at the rod end.

#### NOTE

The strut door cylinder does not incorporate self-aligning bearings. Therefore, it is very important that the strut door cylinder be installed so that its axis is perpendicular to the plane of actuation of the strut door. Add or remove shims as required under the cylinder's side support fittings to accomplish cylinder alignment.

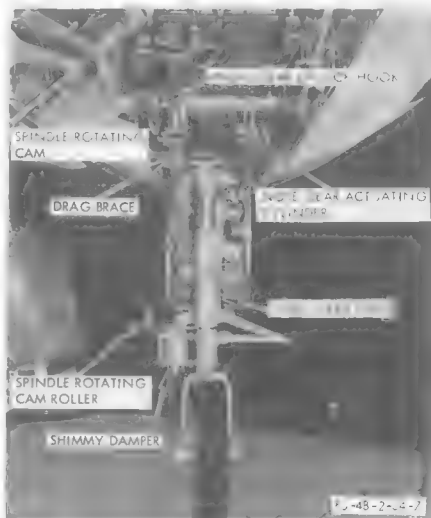
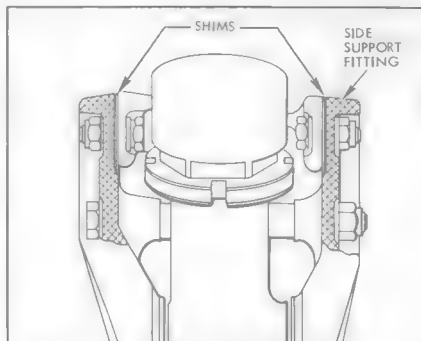
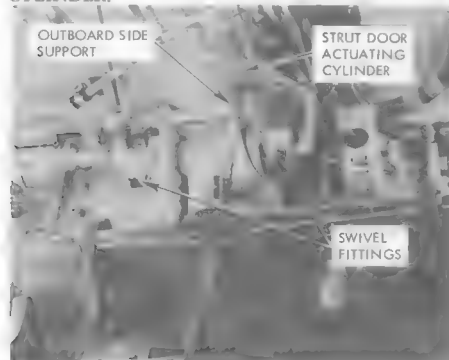


Figure No. 3-40. Nose Landing Gear Assembly

### 3-150. REMOVING AND INSTALLING MAIN LANDING GEAR STRUT DOOR ACTUATING CYLINDER.



**Note** The strut door cylinder does not incorporate self-aligning bearings; therefore, it is very important that the strut door cylinder be installed so that its axis is perpendicular to the plane of actuation of the strut door. Add or remove shims as required under the cylinder side support fittings to accomplish cylinder alignment.

#### REMOVING

- 1** Exhaust hydraulic pressure.
- 2** Open landing gear fairing doors. (Refer to paragraph 3-104.)
- 3** Disconnect two hydraulic lines from swivel fittings on actuating cylinder and cap openings.
- 4** Remove snap ring, washer and pin securing rod end of actuating cylinder to strut door linkage.

**Note** Door lock actuating lever must be disconnected from lock assembly housing to gain access to cylinder's attaching point.

- 5** Break safety wire and remove two swivel fittings from actuating cylinder.
- 6** Remove six nuts, washers and bolts and two spacers joining outboard cylinder side support to support assembly and bottom of actuating cylinder support fitting.

**Note** Do not remove bolts joining cylinder fitting to wing spar. Remove strut door actuating cylinder and outboard cylinder side support from strut well.

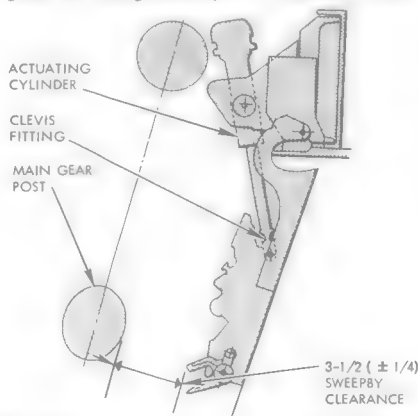
#### INSTALLING

- 1** Position strut door actuating cylinder to fit on support fitting so that forged ridge on cylinder body is facing outboard.

**Note** Make sure ridge on cylinder body is facing outboard; if cylinder is installed with ridge facing inboard, the cylinder will operate in reverse.

- 2** Install outboard cylinder side support and install spacers, bolts, washers and nuts to join side support and cylinder to cylinder support.

- 3** Install swivel fittings on actuating cylinder and safety with AN995F41 lockwire.
- 4** Remove caps and connect hydraulic line to cylinder.
- 5** With cylinder fully extended, adjust clevis fitting at rod end to obtain a 3-1/2 (±1/4)-inch sweepby clearance between strut door lock hook and main gear post. Tighten clevis fitting and safety with AN995F32 lockwire.

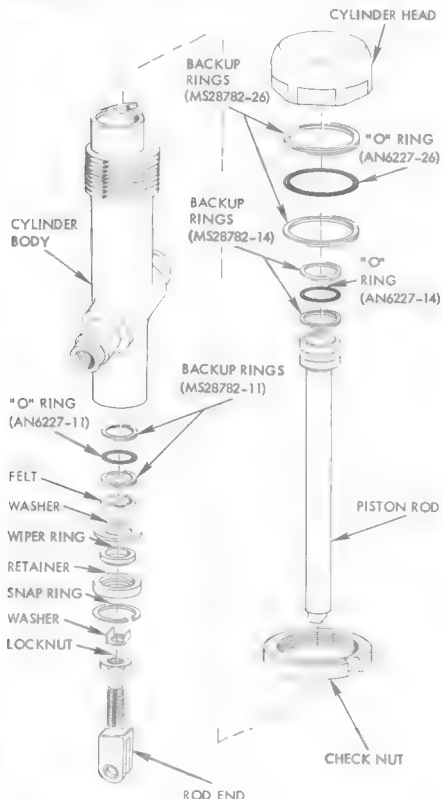


- 6** Install pin, washer and lock ring securing cylinder to door lock actuating lever.
- 7** Connect door lock actuating lever to lock assembly housing.
- 8** Check landing gear system. (Refer to paragraph 3-106.)

3-151. DISASSEMBLING AND ASSEMBLING MAIN  
LANDING GEAR STRUT DOOR ACTUATING  
CYLINDER.

## DISASSEMBLING

- 1 Secure actuating cylinder in holding device.
- 2 Loosen locknut securing rod end and remove rod end, lock washer and locknut from piston rod.
- 3 Remove snap ring, retainer, wiper ring, washer and felt from end of cylinder body.
- 4 Loosen check nut and remove cylinder head and check nut from cylinder body.
- 5 Remove piston rod from cylinder body.



**Note** Clean all metal parts with Stoddard Solvent (item 119, materials list).

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## ASSEMBLY

**Note** Prior to assembly, inspect all metal parts for cleanliness and condition; replace as required. Replace all "O" ring packings and backup rings. Refer to General Information, Section III.

BEARING TOLERANCES CHART

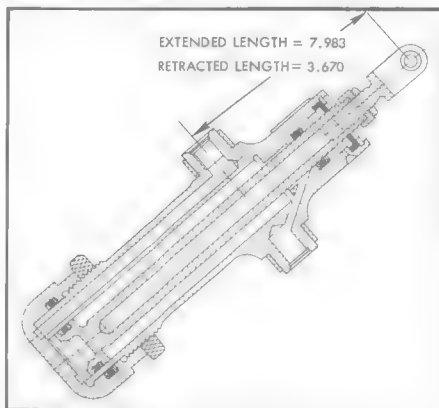
NOMENCLATURE	NORMAL DIMENSION	REPLACE AT
CYLINDER BODY ID	$\frac{0.936}{0.938}$	0.939
CYLINDER BORE ID (PISTON ROD BEARING SURFACE)	$\frac{0.563}{0.564}$	0.565
PISTON HEAD OD	$\frac{0.9335}{0.9345}$	0.9325
PISTON ROD OD	$\frac{0.559}{0.560}$	0.558

- 1 Assemble cylinder in reverse sequence of disassembly procedure.

**Note** When installing the cylinder head, do not use head to adjust cylinder stroke. Install head until bottomed on cylinder body. Adjust cylinder stroke at rod end.

- 2 After assembly is completed, check cylinder break-out friction by hand. Break-out friction shall not exceed 40 pounds. Piston must move in and out smoothly.

- 3 To proof test cylinder, apply 4500 psi for two minutes, first to one port and then the other, with the piston bottomed at the opposite end and the opposite port open. There shall be no external or internal leakage or damage to the cylinder.



- 4 To test cylinder for external leakage, operate cylinder through five complete cycles at 3000 psi. Leakage around piston rod shall not exceed one drop in 25 cycles.

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3-152. MAIN LANDING GEAR TRUNNION FAIRING. The main landing gear trunnion fairing fairs the main gear trunnions and the outboard edge of the strut well. It is attached outboard of the gear to the strut well structure by two hinges and it is attached to the main gear post by a bungee. The trunnion fairing follows the movement of the main gear and is faired to the airplane's mold line by the adjustable clevis fitting on the bungee. The function of the bungee is to permit the main landing gear strut to fall far enough to engage the emergency release bell crank on the strut door locking mechanism during an emergency extension. This is required because the strut door overlaps the trunnion fairing.

3-153. REMOVING MAIN LANDING GEAR TRUNNION FAIRING.

- a. Remove cotter pin, nut, washer and bolt attaching trunnion fairing to bungee.
- b. Disconnect bonding wire from fairing.
- c. Support fairing and remove cotter pins, nuts, washers and bolts attaching fairing's forward and aft hinge to the structure.
- d. Remove fairing from airplane.

3-154. INSTALLING MAIN LANDING GEAR TRUNNION FAIRING.

- a. Position fairing to fit at hinge points and install bolts, washers, nuts and cotter pins securing fairing to structure.
- b. Adjust clevis end of bungee to fair trunnion fairing to the airplane's mold line without distorting the outer skin.
- c. Secure bonding wire to fairing.
- d. Install bolt, washer, nut and cotter pins securing trunnion fairing to bungee.

3-155. MAIN LANDING GEAR WHEELS.

3-156. Each main landing gear assembly is equipped with a Type VII, 26 by 6.6 wheel assembly. The wheels are of the split-type and consist of two forged magnesium sections held together by bolts. Steel drive keys are attached to the outer rim on the inside of the wheel to drive the rotating disks on the brake assembly. Mounted on each wheel is a Type VII, tubeless tire with a 14-ply rating. The tire is constructed so that, when mounted, the bead of the tire contacts the wheel flange and provides a seal. A gasket installed between the wheel sections also provides a seal.

3-157. REMOVING MAIN LANDING GEAR WHEELS.

- a. Jack landing gear strut of wheel being removed. (Refer to paragraph 1-43.)
- b. Remove lock ring and dust cover from outboard side of wheel.
- c. Remove cotter pin, retaining nut and washer from axle.
- d. Slide wheel outboard on axle far enough to remove outboard bearings.
- e. Remove outboard bearings.

- f. Remove wheel from axle.
- g. Remove collar from inboard side of axle.
- h. Remove lock ring, shaped bearing closure ring, felt seal, flat bearing closure ring and bearings from outboard side of wheel.

**Note**

Bearings should be wrapped in protective material and placed where they will not collect dirt or become damaged. Do not handle bearings with bare hands; use clean, lint-free cloth or cloth gloves.

3-158. DISASSEMBLING MAIN LANDING GEAR WHEELS.

- a. Remove valve cap and deflate tire by removing valve core.
- b. Break tire beads from wheel flanges by applying an even pressure around the entire circumference of each side wall.

**CAUTION**

Do not pry between wheel flange and tire bead with a sharp object or wheel may be damaged, destroying its sealing qualities.

- c. Remove cotter pins and locking clips from wheel section tie bolts.
- d. Remove the 12 wheel section tie bolts and washers.
- e. Separate wheel sections and remove tire.
- f. Remove wheel section sealing gasket.
- g. Remove nut and washers attaching valve stem to wheel section.
- h. Remove valve stem and "O" ring seal from wheel section.

**Note**

Although seldom necessary, brake disk drive keys may be removed by boiling screws and heating wheel section in boiling water for 1/2 hour. If necessary to remove bearing cups, do so by first heating wheel sections for 1/2 hour in boiling water; then, force out bearing cups by applying even pressure to the bottom of the cups.

3-159. ASSEMBLING MAIN LANDING GEAR WHEELS.

**Note**

If brake disk drive keys and bearing cups were removed prior to assembly of wheel, proceed as follows:

- Heat wheel section in boiling water for 1/2 hour and chill drive keys on dry ice.
- Paint keyways on wheel with zinc chromate paste or primer (item 102, materials list).

- a. Install "O" ring seal (AN6227-8) and valve stem in wheel section; secure with washer and nut.
- b. Place inboard wheel section on a flat surface and install wheel section gasket in groove provided.
- c. Position tire on wheel section so balance mark (red dot) on side wall is aligned with the valve stem.
- d. Position outboard wheel section so valve stem hole aligns with valve stem.

**CAUTION**

- Check part numbers of the bolts to ensure that only the specified bolts for the wheel assembly are being used. The part number is impressed in the side of the bolthead.
  - If one bolt in a wheel assembly is considered faulty, replace all twelve bolts with new bolts.
  - Do not salvage bolts from used or damaged wheel assemblies. The only bolts in the tire shop should be new bolts and bolts packaged and attached to the wheel assemblies from which they were removed.
  - If, in some cases, it becomes absolutely necessary to use old bolts, have the bolts dye-penetrant checked.
  - Care must be used to prevent damage to wheel section gaskets when mating wheel sections.
- e. Compress wheel sections enough to allow installation of four wheel section tie bolts and washers 90 degrees apart. Draw bolts up evenly until wheel sections seat; then, install remaining wheel section tie bolts and washers.

**CAUTION**

- Lubricate wheel section tie-bolt threads, bolt-heads and bearing surface of washer with anti-seize compound (item 131, materials list.)
  - Install the chamfered washer with the countersink facing the bolthead.
- f. Tighten the wheel section tie bolts evenly in increments of 5 foot-pounds until the proper torque value of 25 foot-pounds is reached.

**Note**

It is recommended that wheel section tie bolts be tightened and torqued in a crisscross order.

- g. Install locking clips over wheel section tie-bolt heads and secure with cotter pins.
- h. Inflate tire to correct pressure and install valve cap. (Refer to paragraph 1-46.)

### 3-160. INSTALLING MAIN LANDING GEAR WHEELS.

**Note**

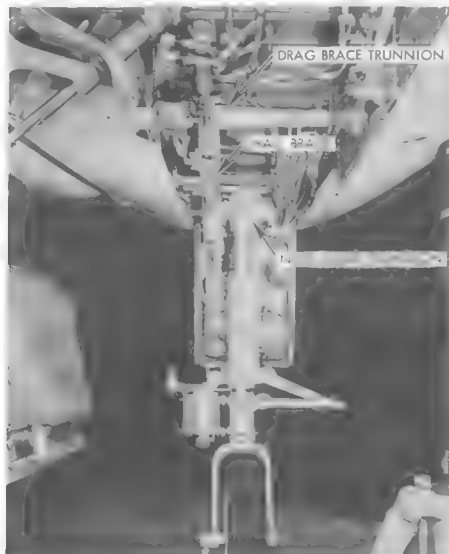
Prior to installation, pack bearings with clean grease (item 83, materials list) and lubricate felts with light machine oil. Do not handle bearings with bare hands but use clean, lint-free cloth or gloves.

- a. Place inboard bearings in wheel and install flat bearing closure ring, felt seal, shaped bearing closure ring and lock ring on inboard side of wheel.
- b. Install spacer over axle.
- c. Install wheel on axle and slide inboard until contact is made with brake disks.
- d. Align brake disks to engage drive keys and continue sliding wheel inboard until flush against spacer.
- e. Install outboard bearing, washer and retaining nut.
- f. Tighten the retaining nut with a wrench, while turning the wheel in both directions, until the wheel binds slightly to ensure that all bearing surfaces are in contact.
- g. Back off the retaining nut  $1/16$  to  $1/4$  turn, or to the nearest locking hole, or sufficiently to allow the wheel to rotate freely within the limits of 0.001 to 0.010 inch of end play.
- h. Secure retaining nut with cotter pin.
- i. Install dust cap and lock ring on outboard side of wheel.
- j. Check wheel to see that it turns freely, but that it cannot be wobbled sideways.
- k. Remove jack.

### 3-161. NOSE LANDING GEAR ASSEMBLY.

3-162. The nose landing gear is a conventional-type gear that supports the fuselage nose section. It retracts aft and up into the fuselage by means of a hydraulic cylinder. The nose landing gear assembly pivots on trunnion support fittings that are attached to the fuselage nose structure. The nose gear consists of a conventional-type, air-oil shock strut, a shimmy damper with a centering device and a 20 by 4.4 wheel, tire and tube. As the nose gear is retracted, the strut spindle rotates in the spindle housing 90 degrees to position the wheel horizontally to the fuselage. Rotation of the shock strut spindle is accomplished by the shimmy damper torque arm engaging a cam on the fuselage structure as the nose gear is retracting. The nose gear is locked in the down position by a spring-loaded pin in the drag brace. An uplock mechanism, consisting of a roller on the gear strut and an uplock hook in the gear well, is provided to lock the gear in the retracted position. A single hydraulic cylinder integral within the drag brace actuates both the uplock and downlock mechanisms. The shimmy damper prevents rapid oscillation while landing or taxiing. The nose gear is completely faired, when in the retracted position, by a strut fairing and a wheel door. A "one shot" emergency extension system aids the nose gear to the down and locked position during an emergency extension. (See figure 3-40.)

3-163. REMOVING, INSTALLING AND ADJUSTING NOSE LANDING GEAR ASSEMBLY.



REMOVING

- 1** Exhaust hydraulic pressure.
- 2** Open landing gear doors. (Refer to paragraph 3-104.)
- 3** Place airplane on jacks. (Refer to paragraph 1-14.)
- 4** Remove wheel assembly. (Refer to paragraph 3-189.)
- 5** Exhaust hydraulic pressure (nose gear emergency extension system).
- 6** With nose gear in the down and locked position, remove keeper bolt from pin securing drag brace to nose strut.
- 7** Remove tapered pin securing drag brace to strut.
- 8** Partially retract nose gear and remove cotter pin, nut, washers and bolt securing nose gear actuating cylinder to nose gear.
- 9** Remove nuts, washer, serrated plates and bolt securing upper end of strut door to nose gear trunnion pin keeper bolts.
- 10** Remove nut, washer and bolt securing lower end of strut door to strut.

**Note** Support weight of door to prevent damage to landing light electrical wiring.

- 11** Remove trunnion pin keeper bolts from each side of nose gear trunnion.
- 12** Gain access to trunnion pins by removing the trunnion pin access panels on each side of the fuselage.
- 13** Remove cotter pins and nuts from both trunnion pins.
- 14** Support nose gear and remove trunnion pins.
- 15** Remove nose gear from airplane.

**Note** It is not necessary to remove drag brace and drag brace trunnion to remove the nose landing gear.

To remove the drag brace and drag brace trunnion, proceed as follows:

- 1** Disconnect hydraulic lines from nose gear actuating cylinder and cap openings.
- 2** Remove cotter pin, nut, washer and bolt securing nose gear cylinder to drag brace trunnion.
- 3** Remove actuating cylinder from airplane.
- 4** Remove nut, washer and bolt securing nose gear uplock hook to drag brace.
- 5** Disconnect uplock hook slotted linkage from uplock and downlock cylinder.
- 6** Disconnect hydraulic lines from drag brace and cap openings.
- 7** Remove downlock switch from drag brace.
- 8** Remove keeper stud and washer from pin securing drag brace to trunnion.
- 9** Rotate drag brace trunnion forward; support drag brace and remove pin securing drag brace to trunnion. Remove drag brace from airplane.
- 10** Remove keeper bolts from each end of drag brace trunnion.
- 11** Support drag brace trunnion and remove trunnion pins.

**Note** Access to drag brace trunnion pins is gained through equipment compartment doors on each side of forward fuselage.

- 12** Remove drag brace trunnion from airplane.

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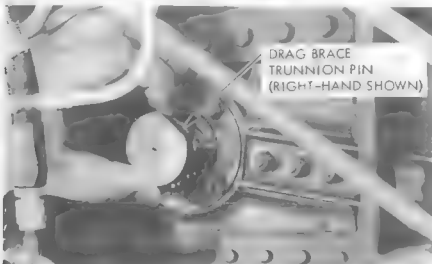
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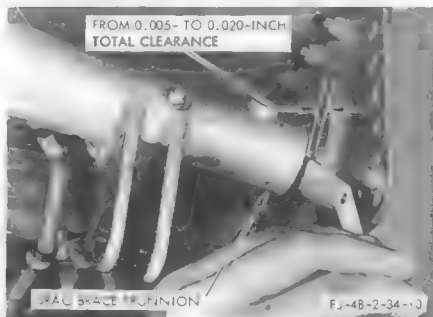
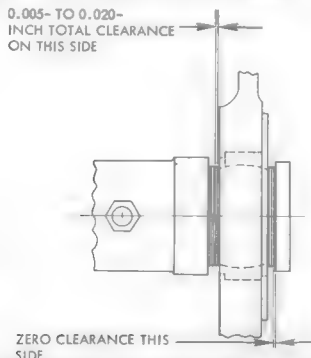
## INSTALLING

**Note** If drag brace and drag brace trunnion were removed from airplane, install and adjust with installation of nose gear as outlined in the following procedure.

- 1** Install drag brace trunnion to fit on trunnion support and insert drag brace trunnion pins.



- 2** Use shims as required to obtain from 0.005- to 0.020-inch clearance between trunnion and support.



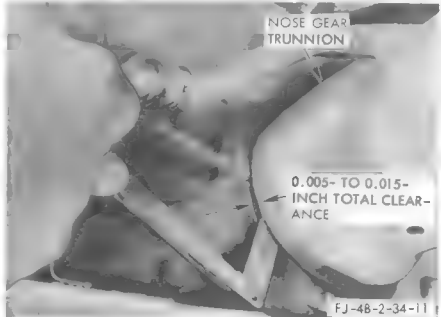
- 3** Install drag brace trunnion pin keeper bolts and secure with nuts and washers.

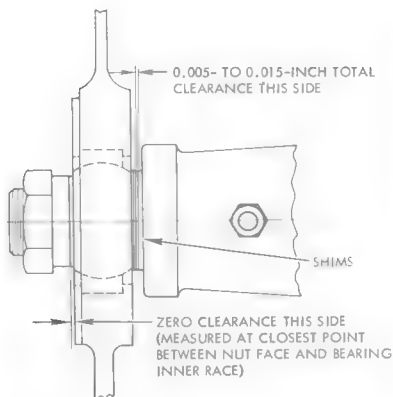


- 4** Position nose gear trunnion to fit on trunnion support and insert nose gear trunnion pins.



- 5** Use shims as required to obtain from 0.005- to 0.015-inch clearance between nose gear trunnion and trunnion mounts.





**Note** Difficulties may be encountered when inserting shims to obtain clearance in step 5. It is recommended that trunnion pins be inserted through trunnion mounting structure and extended beyond structure enough to install shims prior to positioning trunnion to fit on mounting structure.

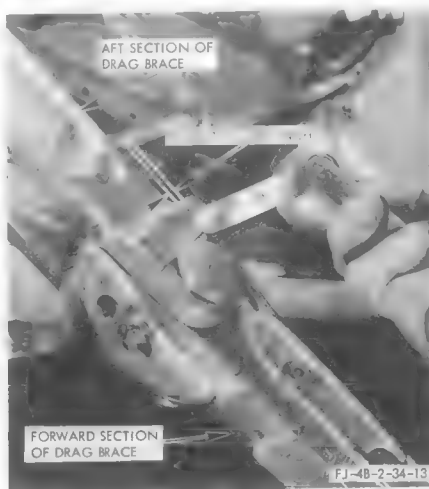
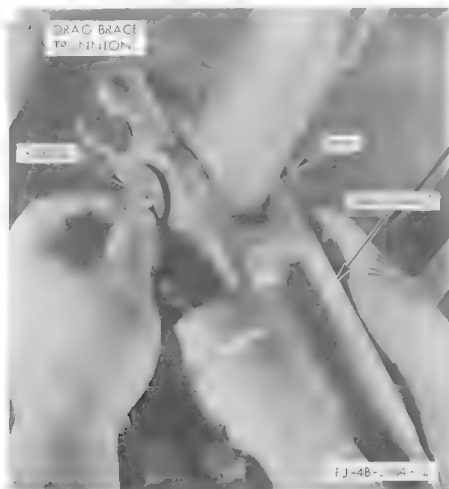
**6** Position drag brace to fit between attaching points and install pin and keeper stud attaching drag brace to nose gear trunnion. Safety keeper stud with AN995F41 lockwire.

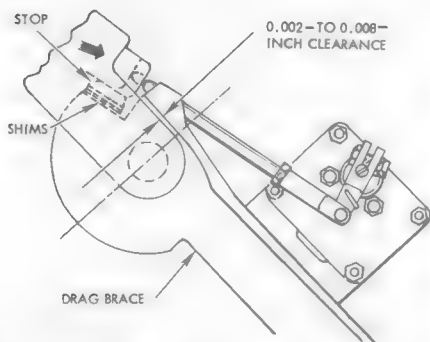
**7** Install tapered pin and keeper bolt attaching drag brace to nose gear strut.



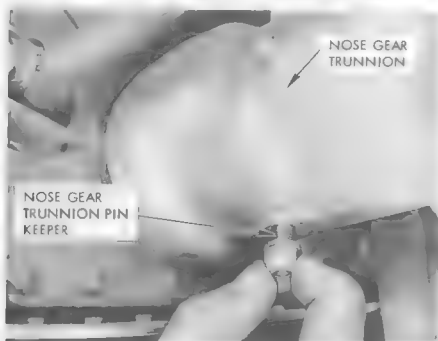
**8** With drag brace partially folded, use shims as required under stop in drag brace to obtain from 0.002- to 0.008-inch clearance between drag brace sections when the drag brace is down and locked.

**Note** With no pressure present, force up on the lower side of the drag brace to check this clearance.





- 9** Install nose gear trunnion pin keeper bolts through trunnion and pin. Secure with washers and nuts.

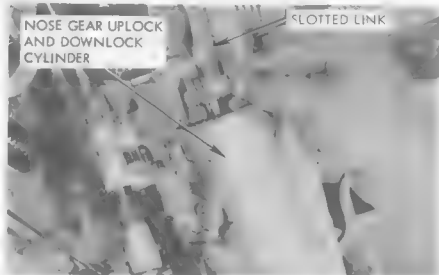


- 10** Remove caps and connect hydraulic lines to nose gear uplock and downlock actuating cylinder.

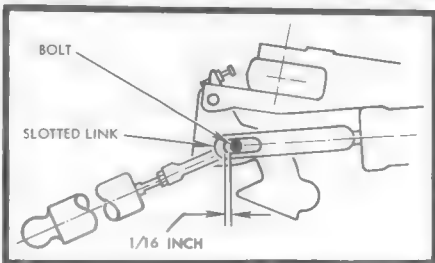
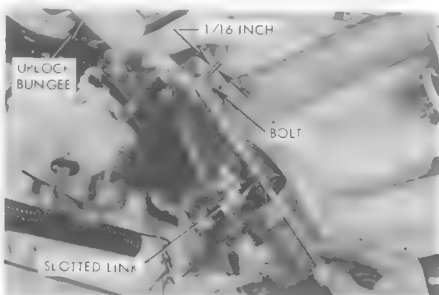
- 11** Install nose gear uplock hook on drag brace arm and secure with bolt and nut.



- 12** Install uplock hook slotted actuating link to uplock and downlock cylinder and secure with bolt, washers, nut and cotter pin.



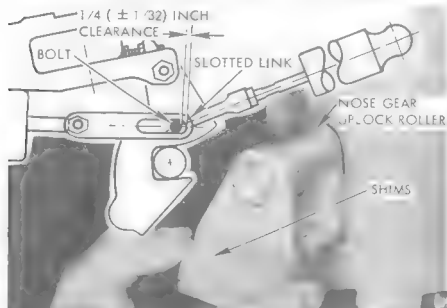
- 13** With the nose gear in the down and locked position and the up and downlock cylinder bottomed in the down position, adjust uplock bungee to obtain 1/16-inch clearance between the slotted actuating link and its attaching bolt. Install bungee.



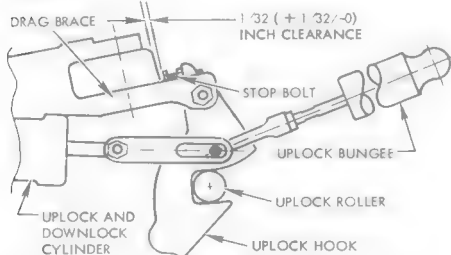
- 14** Manually retract the nose gear to up and locked position. With uplock and downlock cylinder fully extended, use shims as required under nose gear uplock roller mounting bracket to obtain 1/4 (±1/32) inch clearance between slotted actuating link and its attaching bolt.

FJ-48-2-34-15

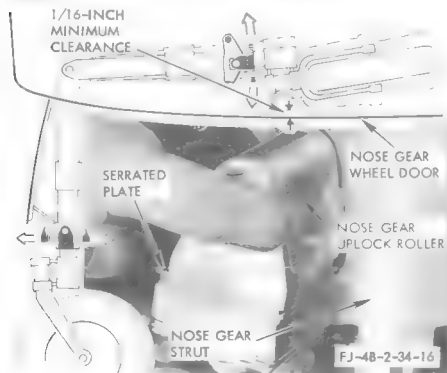
**Caution** Nose gear must be extended before removing uplock roller to insert shims.



**15** Manually retract nose gear to the up and locked position and adjust uplock hook stop bolt to obtain 1/32 (+1/32/-0) inch clearance between stop bolt and stop on drag brace.

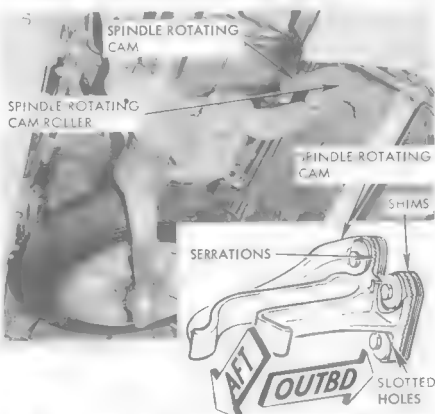


**16** Adjust nose gear uplock roller forward or aft on its serrations to obtain 1/16-inch minimum clearance between lowest part of nose gear and inner skin of wheel door when the gear is up and locked and wheel door is closed.

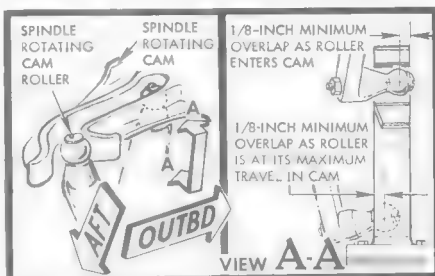


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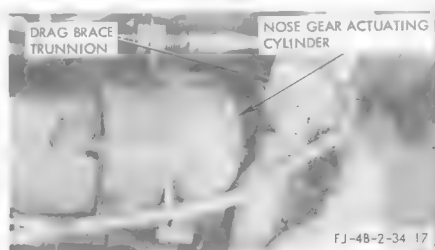
**17** Use slotted holes, shims and serration on spindle rotating cam to obtain a 90 (±5) degree rotation of nose gear wheel in the retracted position.



**Note** Check that 1/8-inch overlap is present between spindle cam roller and cam just as roller enters cam and when roller is at its maximum travel in cam.

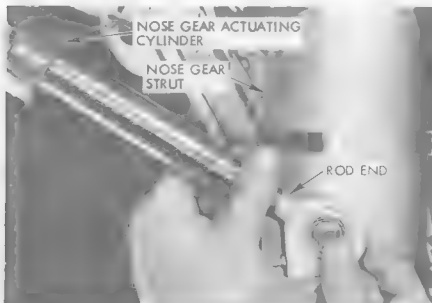


**18** With the nose gear down and locked, attach nose gear actuating cylinder to drag brace trunnion and secure with bolt, washers, nut and cotter pin.

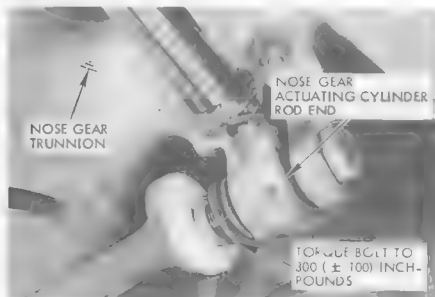


FJ-48-2-34 17

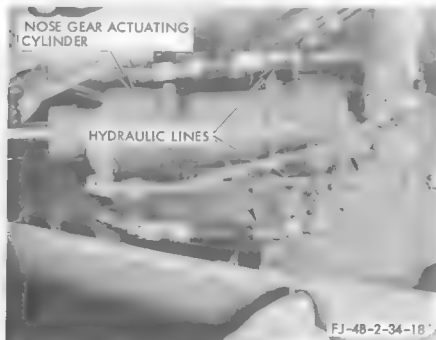
- 19** Adjust actuating cylinder extended length to fit on nose gear trunnion; then lengthen rod end four complete turns. Tighten locknut and safety with AN995F42 lockwire.



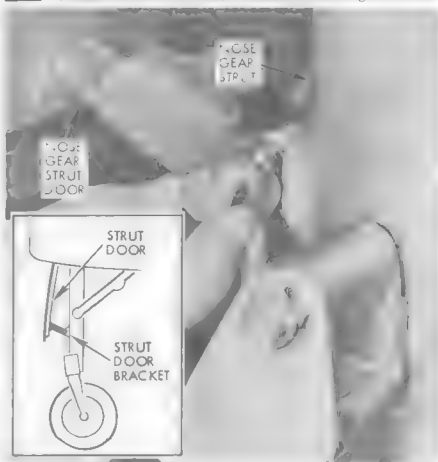
- 20** Partially fold nose gear and install bolt, washers and nut securing cylinder rod end to nose gear trunnion.



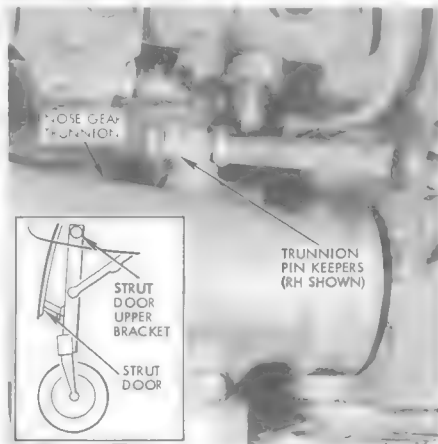
- 21** Remove caps and connect three hydraulic lines to nose gear actuating cylinder.



- 22** Connect strut door lower bracket to nose gear strut.



- 23** Connect strut door upper bracket to nose gear trunnion keeper bolt and use slotted holes, serrated plates and washers to fair door to the airplane mold line when nose gear is retracted.



- 24** Adjust nose landing gear uplock and downlock switches. (Refer to paragraph 3-117.)

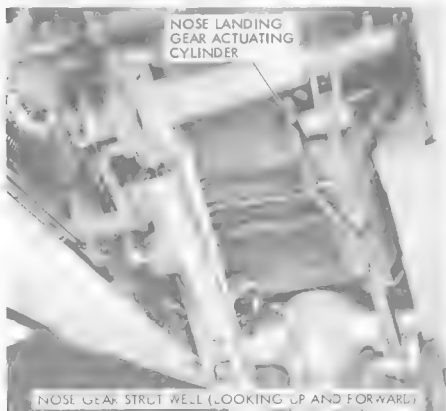
- 25** Check landing gear normal and emergency extension systems for operation. (Refer to paragraphs 3-106 and 3-198.)

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3-164. SERVICING NOSE LANDING GEAR SHOCK STRUT. Refer to paragraph 1-43.

3-165. NOSE LANDING GEAR ACTUATING CYLINDER. The nose landing gear actuating cylinder extends and retracts the nose gear. The cylinder is located in the forward right-hand corner of the nose gear well and is attached to the drag brace trunnion at its trunnion end and to the strut trunnion at its rod end. When the actuating cylinder is retracting or extending, the floating action of the cylinder body moves the nose gear drag brace overcenter in the up or down position. The piston rod length can be varied by adjusting the rod end. The nose gear cylinder is a double acting, unbalanced-type unit, rated at 3000 psi.

3-166. REMOVING AND INSTALLING NOSE LANDING GEAR ACTUATING CYLINDER.



#### REMOVING

- 1 Place airplane on jacks. (Refer to paragraph 1-14.)
- 2 Exhaust hydraulic pressure.
- 3 Disconnect three hydraulic lines from cylinder and cap openings.
- 4 Manually disengage downlock pin and partially retract nose gear. Remove nut, washers and bolt securing rod end of cylinder to nose gear trunnion.
- 5 Support cylinder and remove cotter pin, nut, washer and bolt securing trunnion end of cylinder to drag brace trunnion.
- 6 Remove cylinder from nose gear strut well.

#### INSTALLING

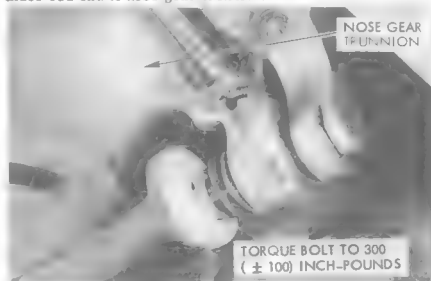
- 1 Position cylinder trunnion end to fit at mounting support on drag brace trunnion and install bolt, washer and nut. Secure nut with cotter pin.



- 2 With nose gear down and locked and cylinder fully extended, adjust rod end to fit at attaching point on nose gear trunnion. Lengthen rod end four full turns; tighten rod end locknut and safety with AN995F32 lockwire.



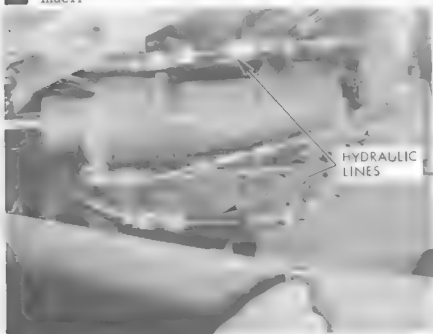
- 3 Manually disengage downlock pin and partially retract nose gear. Install bolt, washers and nut securing cylinder rod end to nose gear trunnion.



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- 4** Remove caps and connect three hydraulic lines to cylinder.



- 5** Check landing gear system. (Refer to paragraph 3-106.) FJ-4B-2-34-27

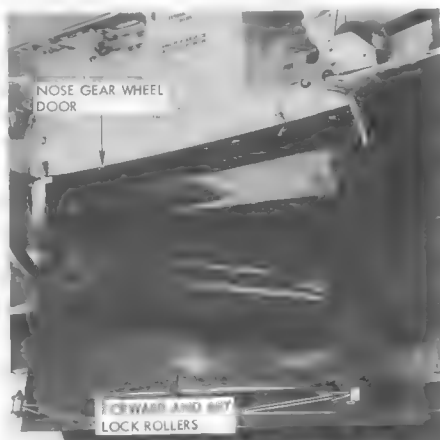
**3-167. NOSE LANDING GEAR UPLOCK AND DOWNLOCK ACTUATING CYLINDER.** The nose gear uplock and downlock actuating cylinder moves the downlock pin and the uplock hook to their respective unlocked positions. The cylinder is an integral part of the upper link on the drag brace. It is a balanced-type unit, rated at 3000 psi. The lower rod end of the piston fits into and unlocks the spring-loaded downlock pin. The upper rod end of the piston is attached to the uplock hook's slotted linkage. The uplock hook and the downlock pin are spring-loaded to the locked position.

**3-168. REMOVING AND INSTALLING NOSE LANDING GEAR UPLOCK AND DOWNLOCK ACTUATING CYLINDER.** The nose landing gear uplock and downlock actuating cylinder is integral within the drag brace; therefore, the drag brace must be removed. For removal and installation of the drag brace, refer to paragraph 3-163.

**3-169. NOSE LANDING GEAR FAIRING DOORS.** When in the retracted position, the nose landing gear assembly is completely faired within the airplane's outer surface by a hydraulically operated wheel door and a strut fairing that is rigidly attached to the nose strut.

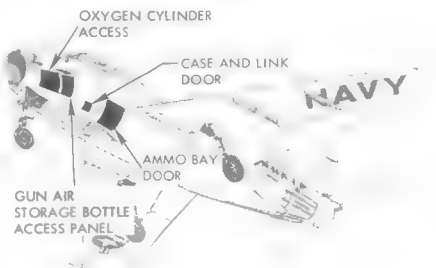
**3-170. NOSE LANDING GEAR WHEEL DOOR.** The nose landing gear wheel door fairs the nose gear shock strut and wheel well. (See figure 3-41.) The door is hinged to the left side of the nose gear wheel well structure by two hinges. The door is opened and closed by a hydraulic cylinder. An overcenter-type locking mechanism, located along the right-hand side of the nose gear wheel well, locks the wheel door in the closed position. The locking mechanism is actuated by the door lock cylinder. The landing gear emergency extension cable is attached to the locking mechanism to provide a means for manually releasing the door lock hooks. The door lock roller can be adjusted in or out on a serrated plate to fair the door to the airplane's mold line.

### 3-171. REMOVING, INSTALLING AND ADJUSTING NOSE LANDING GEAR WHEEL DOOR.



#### REMOVING

- 1** Remove bolt attaching door actuating cylinder rod end to door forward hinge.
- 2** Disconnect bonding wire from door.
- 3** Gain access to forward and aft door hinge bolts through the oxygen cylinder door, gun air storage bottle access panel, case and link door and the ammo bay door (left-hand side of airplane).



- 4** Support door and remove bolts, washers and nut attaching forward and aft door hinges to supports.
- 5** Remove door from airplane. FJ-4B-2-34-1

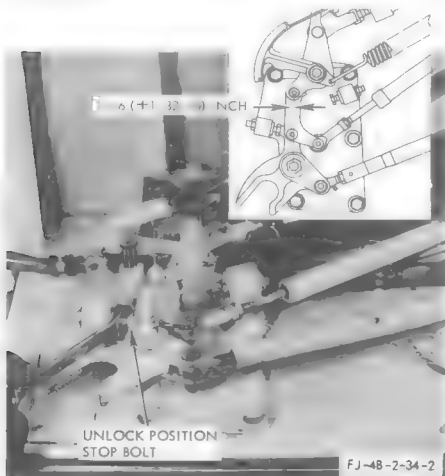




## INSTALLING

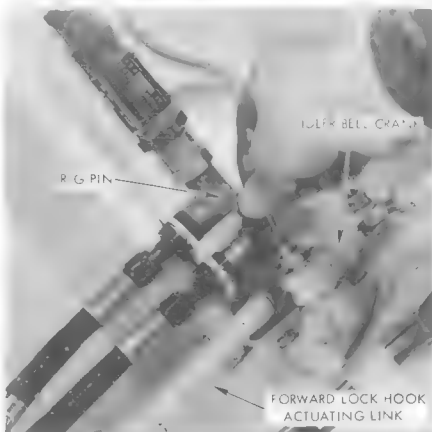
**1** Position door to fit on hinge supports and install bolt, washer and nut securing forward and aft hinge to support. Connect bonding wire to door.

**2** Rotate forward lock hook to the unlocked position and adjust the unlock stop bolt to obtain 1/16 (+1/32/-0) inch overcenter condition of door locking mechanism.



**3** Install 3/16-inch rig pin through idler bell crank.

**4** Adjust forward lock hook actuating link to fit between attaching points on idler bell crank and forward lock hook. Install.



**5** Install 3/16-inch rig pin through aft lock hook.

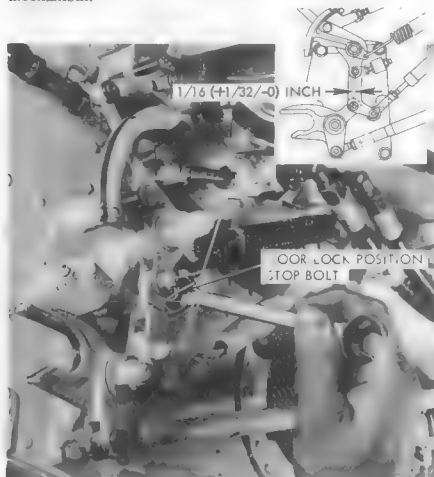


**6** Adjust aft lock hook actuating link to fit between idler bell crank and aft lock hook. Install.

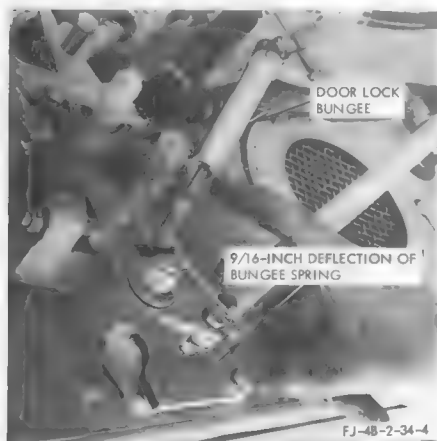
**7** Remove rig pins.

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- 8** Manually rotate door locking mechanism to the locked position and adjust lock stop bolt to obtain 1/16 (-1/32/+0) inch overcenter condition of mechanism.



- 9** With the locking mechanism in the unlocked position, adjust free length of bungee to obtain a 9/16-inch deflection of bungee spring and install.



- 10** With the locking mechanism in the unlocked position and the lock cylinder fully compressed, adjust cylinder at rod end to fit between attaching points. Shorten rod end three full turns and install cylinder. Check for 1/8-inch minimum overtravel when cylinder is fully extended.

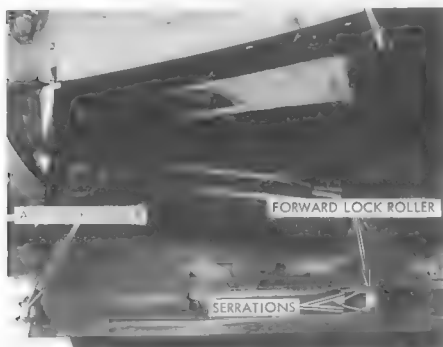
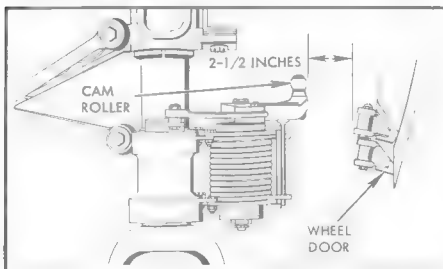


**Caution** When connecting rod end of wheel door lock cylinder, make sure grease fitting is pointed upward. If rod end is installed with grease fitting pointing downward, it may bind on lock linkage and prevent door from unlocking.

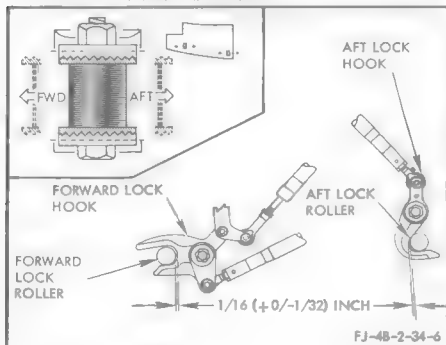
- 11** With the door actuating cylinder fully extended, adjust rod end to obtain 15-15/16-inch length of cylinder between centers of attaching points. Install bolt attaching rod end of cylinder to forward hinge of door.



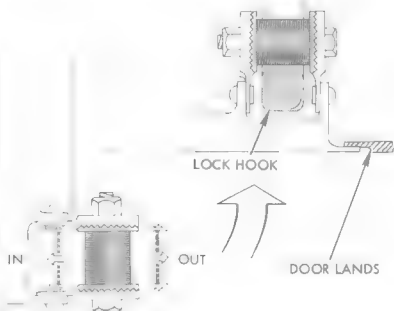
**Note** Sweepby clearance of spindle rotating cam roller and door is 2-1/2 inches minimum. Readjust actuating cylinder rod end if necessary to maintain this sweepby clearance.



**12** Adjust forward and aft rollers forward or aft on their serrations to obtain a 1/16 (+0/-1/32) inch clearance between the lock hooks and the rollers when the door is closed and locked.



**13** Adjust forward and aft rollers in or out on their serrations to rig the door firmly against the door lands without distorting the outer skin of door in the closed and locked position.



Distortion of outer skin will result from positioning roller too far in on its serrations.

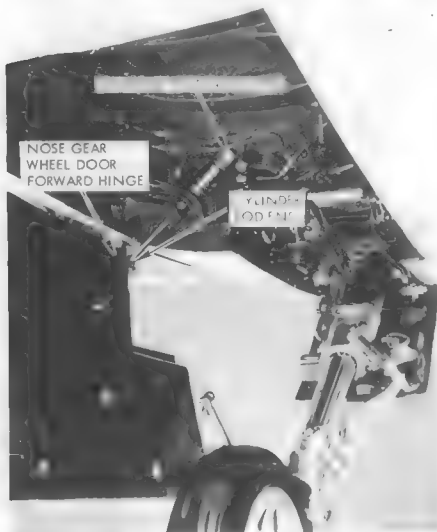


**14** Properly adjust nose gear door open, closed and locked switches. (Refer to paragraph 3-117.)

**15** Check landing gear normal and emergency extension systems. (Refer to paragraphs 3-106 and 3-198.)

3-172. NOSE LANDING GEAR WHEEL DOOR ACTUATING CYLINDER. The nose landing gear wheel door actuating cylinder opens and closes the nose gear wheel door. The hydraulic cylinder is attached at its trunnion end to the structure at the top of the wheel well and at its rod end to the forward door hinge. The cylinder is a double acting, unbalanced-type unit, rated at 3000 psi. Piston rod length can be varied by the adjustable rod end.

3-173. REMOVING AND INSTALLING NOSE LANDING GEAR WHEEL DOOR ACTUATING CYLINDER.



#### REMOVING

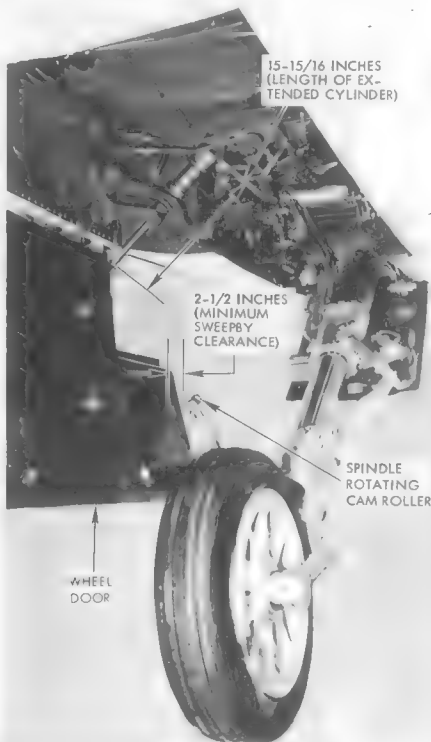
- 1 Exhaust utility hydraulic pressure.
- 2 Open landing gear doors. (Refer to paragraph 3-104.)
- 3 Disconnect two hydraulic lines and cap openings.
- 4 Remove bolt and washer securing cylinder rod end to forward hinge on door.
- 5 Support cylinder and remove cotter pin, nut, washer and bolt securing trunnion end of cylinder to fuselage structure.
- 6 Remove cylinder from nose wheel well.

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#### INSTALLING

- 1 Position trunnion end of cylinder to fit on fuselage structure and secure with bolt, washers, nut and cotter pin.
- 2 Remove caps and connect two hydraulic lines to cylinder.
- 3 Fully extend actuating cylinder and adjust at rod end to obtain 15-15/16-inch length between centers of attaching points. Tighten rod end locknut and safety with lockwire (AN995F41).
- 4 Connect rod end of cylinder to forward door hinge and secure with bolt and washers.

*Note* Sweepby clearance between spindle rotating cam roller and wheel door must be 2-1/2 inches minimum. Readjust cylinder length if necessary to maintain this clearance.



- 5 Check landing gear system. (Refer to paragraph 3-106.)

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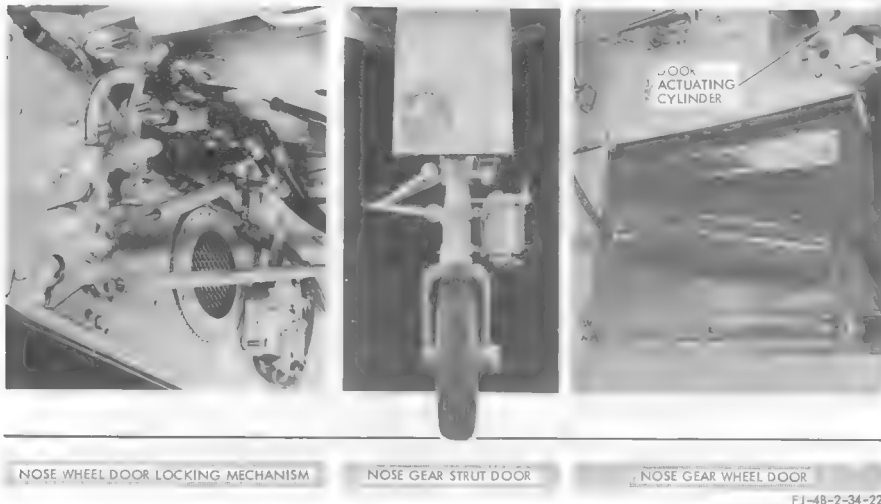


Figure No. 3-41. Nose Landing Gear Fairing Doors

3-174. **NOSE LANDING GEAR WHEEL DOOR LOCK CYLINDER.** The nose landing gear wheel door lock cylinder actuates the door locking mechanism to the locked and unlocked position. It is installed along the right-hand structure in the nose wheel well as a part of the locking mechanism. The cylinder is a double acting, unbalanced-type unit, rated at 3000 psi. Piston rod length can be varied by the adjustable rod end.

3-175. **REMOVING NOSE LANDING GEAR WHEEL DOOR LOCK CYLINDER.**

- a. Open landing gear doors. (Refer to paragraph 3-104.)
- b. Exhaust hydraulic pressure.
- c. Disconnect two hydraulic lines from door lock cylinder and cap openings.
- d. Remove nut, washers and bolt attaching cylinder rod end to locking mechanism.
- e. Support cylinder and remove nut, washers and bolt attaching trunnion end of cylinder to locking mechanism.
- f. Remove door lock cylinder from airplane.

3-176. **INSTALLING NOSE LANDING GEAR WHEEL DOOR LOCK CYLINDER.**

- a. Position trunnion end of cylinder to fit on locking mechanism and secure with bolt, washers and nut.
- b. With locking mechanism in unlocked position, fully compress cylinder and adjust at rod end to fit on attaching point; shorten rod end three full turns and secure to locking mechanism with bolt, washer and nut.



When connecting rod end of wheel door lock cylinder, make sure grease fitting is pointed upward. If rod end is installed with grease fitting pointed downward, it may bind on lock linkage and prevent door from unlocking.

- c. Remove caps and connect two hydraulic lines to cylinder.

- d. Check landing gear system (paragraph 3-106).

3-177. **NOSE LANDING GEAR STRUT FAIRING.** The nose landing gear strut fairing fairs the forward end of the nose gear strut well. (See figure 3-41.) The fairing is rigidly attached to the strut and follows the movement of the gear. The strut fairing is adjusted to the mold line of the wheel well by means of a serrated plate and washers at the attaching points. The strut fairing also houses the landing light.

3-178. **REMOVING NOSE LANDING GEAR STRUT FAIRING.**

- a. Open landing gear doors. (Refer to paragraph 3-104.)
- b. Disconnect landing light electrical wiring clamps from strut fairing.
- c. Remove landing light from strut fairing. (Refer to paragraph 8-138.)
- d. Remove nut, washers and bolt attaching lower end of strut door to strut.

e. Support door and remove nuts, washers, serrated plates and bolts attaching upper end of strut door to strut trunnion pin keeper bolts.

f. Remove fairing from airplane.

### 3-179. INSTALLING AND ADJUSTING NOSE LANDING GEAR STRUT FAIRING.

a. Position upper end of strut fairing to fit at attaching points on strut trunnion pin keeper bolts.

b. Install serrated plates, bolts, washers and nuts securing upper end of strut fairing to strut trunnion pin keeper bolts.

c. Install bolt, washers and nut securing lower end of strut fairing to strut.

d. Install landing light in strut fairing. (Refer to paragraph 8-139.)

e. Secure landing light electrical wiring clamps to strut fairing.

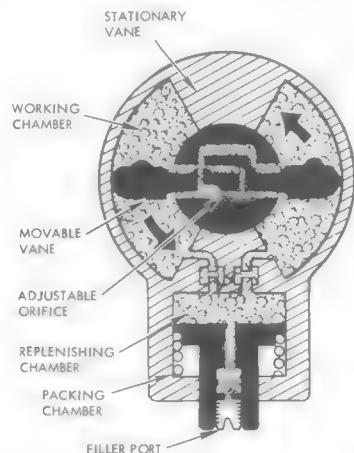
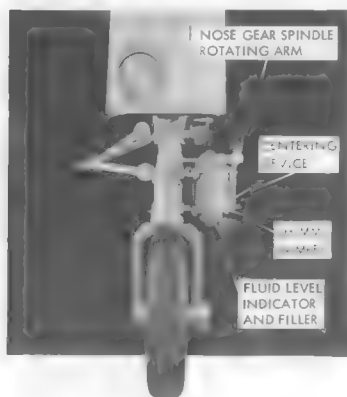
f. Adjust upper end of strut fairing on the serrated plate and add or remove washers at the lower end to fair it with the mold line of the wheel well without distorting the fairing.

g. Check landing gear system. (Refer to paragraph 3-106.)

### 3-180. NOSE LANDING GEAR SHIMMY DAMPER AND CENTERING DEVICE.

3-181. The nose landing gear shimmy damper is of the vane-type and is located on the left-hand side of the nose gear spindle housing. (See figure 3-42.) The damper absorbs torque shock and prevents shimmy during landing or taxiing. The damper allows a relatively

slow movement of rotation through 360 degrees of turning. A torsion spring coiled around the damper acts as a wheel centering device. The torsion spring will return the wheel to the forward center position unless the wheel is rotated more than 70 degrees from forward; in this case, the spring holds the wheel in a crosswise position. The shimmy damper is essentially a reservoir divided into three compartments: a working chamber, a packing chamber and a replenishing chamber. The working chamber houses a movable wing shaft on which are mounted two vanes. Two stationary vanes are fixed in the walls of the working chamber. The wing shaft extends through the packing chamber. The exposed end of the wing shaft is connected to the nose landing gear spindle by linkage. The damping action is transmitted through this linkage. The fluid replenishing chamber at the lower end of the reservoir supplies fluid to the working chamber through check valves. The bottom of the replenishing chamber consists of a spring-loaded piston that maintains fluid at a constant pressure. The fluid level indicator rod is a shaft that protrudes from the bottom of the shimmy damper. It is a part of the spring-loaded piston and directly indicates the piston level. The indicator rod should extend to 17/64 inch and the fluid must be replenished whenever the indicator rod retracts to 9/64 inch. The shimmy damper operates by the combination of fixed and movable vanes in the working chamber. These vanes form two pairs of opposite pressure chambers. Displacement of fluid through variable orifices in the vane walls creates a resistance to shimmy when the movable vanes are positioned in relation to the fixed vanes. The variable orifice can be adjusted to slow down or speed up movement of the movable vanes.



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Figure No. 3-42. Nose Landing Gear Shimmy Damper

3-182. TROUBLE SHOOTING NOSE LANDING GEAR SHIMMY DAMPER.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>EXCESSIVE SHIMMY DURING LANDING OR TAXIING.</b>		
Variable orifice improperly adjusted.	Check for loose fittings and linkage at shimmy damper attaching points. If fittings and linkages are tight, orifice is improperly adjusted.	Adjust to correct setting.
Loose linkage.	Visually check all linkages.	Tighten linkage or replace worn linkage.
<b>FLUID LEVEL CANNOT BE MAINTAINED AND THERE ARE NO SIGNS OF EXTERNAL LEAKAGE.</b>		
Internal leakage around replenishing piston.		Replace shimmy damper.
<b>SHIMMY DAMPER WILL NOT TURN IN EITHER DIRECTION.</b>		
Jacking safety pin left in spindle link.	Visually check.	Remove pin.
Wing shaft locked.		Replace shimmy damper.

3-183. REMOVING NOSE LANDING GEAR SHIMMY DAMPER.

- Disconnect spindle linkage at shimmy damper.
- Remove four bolts attaching shimmy damper to strut spindle housing.
- Remove shimmy damper from airplane.

3-184. INSTALLING NOSE LANDING GEAR SHIMMY DAMPER.

- Position shimmy damper to fit on spindle housing and install four attaching bolts.
- Connect spindle linkage to shimmy damper.

**Note**

Nose wheel must be centered and spindle rotating arm must be indexed on shimmy damper when connecting spindle linkage to shimmy damper.

- Properly service shimmy damper (paragraph 1-50).
- Check shimmy damper for correct operation by taxiing airplane.

3-185. ADJUSTING NOSE LANDING GEAR SHIMMY DAMPER. If shimmy continues after the shimmy damper has been serviced and checked for proper functioning, adjust the variable orifice as instructed in the following procedures:

- Break lockwire and remove dust cap from top of shimmy damper.
- Check that the arrow, scribed on the valve head, is midway between the marks "O" (open) and "C" (closed) on the shaft. The arrow should also be aligned with a factory scribe mark on the shaft.
- Adjust valve, if necessary, so arrow is aligned with factory scribe mark.

- If further adjustment is needed, insert a screwdriver in the slot provided on the valve and turn in the desired direction.

**Note**

Clockwise turning increases damper resistance; counterclockwise turning decreases damper resistance.

**CAUTION**

Turning of the valve should never exceed 1/16 inch at any one time and taxiing tests should be made after each adjustment. Always replace dust cap before taxiing.

- When shimmy damper is correctly adjusted, replace dust cap and safety with lockwire.

3-186. SERVICING NOSE LANDING GEAR SHIMMY DAMPER. Refer to paragraph 1-50.

3-187. NOSE LANDING GEAR WHEEL.

3-188. The nose landing gear assembly is equipped with a Type VII, 20 by 4.4 wheel assembly. The wheel is of the split-type and consists of two cast magnesium sections held together by bolts. Mounted on each wheel is a Type VII, 20 by 4.4 tire and tube with a 10-ply rating.

3-189. REMOVING NOSE LANDING GEAR WHEEL.

- Jack nose landing gear. (Refer to paragraph 1-14.)
- Remove cotter pin from retaining nut.
- Use spanner wrench and remove axle retaining nut.
- Remove axle from strut fork.
- Remove wheel and spacer from strut fork.



**3-190. DISASSEMBLING NOSE LANDING GEAR WHEEL.**

a. Remove three screws from shaped bearing closure ring on each side of wheel and remove felt seal, flat closure ring and bearings from each side of wheel.

**Note**

Bearings should be wrapped in protective material and placed where they will not collect dirt or become damaged. Do not handle bearings with bare hands; use clean, lint-free cloth or cloth gloves.

b. Remove valve cap and deflate tire.

c. Break tire bead from wheel flange by applying an even pressure around the entire circumference of each side wall.

**CAUTION**

Do not pry between wheel flange and tire bead with a sharp object or wheel may be damaged.

d. Remove eight nuts, washers and bolts attaching wheel sections together.

**WARNING**

Make sure tire is deflated before loosening tie bolts.

e. Separate wheel sections and remove tire.

f. Remove tube from tire.

**3-191. ASSEMBLING NOSE LANDING GEAR WHEEL.**

a. Install tube in tire so balance marks align.

b. Install valve core and partially inflate tube.

c. Place tire and tube on section of wheel with valve stem hole and use blunt tool to work valve stem through hole.

d. Position other section of wheel to align and install wheel section bolts, washers and nuts.

e. Torque bolts evenly to 15 foot-pounds.

f. Properly inflate tire to correct pressure. (Refer to paragraph 1-46.) Install valve cap.

**Note**

Prior to installation, pack bearings with clean grease (item 83, materials list) and lubricate felt seals with light machine oil. Do not handle bearings with bare hands; use clean, lint-free cloth or cloth gloves.

g. Install bearings, flat closure ring, felt seal and shaped closure ring in each side of wheel. Secure with three screws.

**3-192. INSTALLING NOSE LANDING GEAR WHEEL.**

a. Position wheel and spacers in nose gear fork and install axle.

b. Install retaining nut. Tighten the retaining nut with a wrench, while turning the wheel in both directions, until wheel binds slightly to ensure that all bearing surfaces are in contact.

c. Back off the retaining nut 1/16 to 1/4 turn, or to the nearest locking hole, or sufficiently to allow the wheel to rotate freely within the limits of 0.001 to 0.010 inch of end play.

d. Secure retaining nut with cotter pins and check wheel for drag by spinning.

e. Remove jack from nose gear strut.

**3-193. LANDING GEAR EMERGENCY EXTENSION SYSTEM.**

3-194. The landing gear emergency extension system is an entirely separate control system. The emergency extension system is actuated by a red control handle (EMG. LDG. GR. RELEASE), located to the right of the instrument panel, and a series of cables which are routed to the various landing gear components. A "one shot" accumulator system is used to extend the nose gear against the air stream. (See figure 3-43.)

**3-195. FUNCTION OF LANDING GEAR EMERGENCY EXTENSION SYSTEM.**

3-196. The emergency extension system is actuated by pulling out the EMG. LDG. GR. RELEASE handle, located on the right-hand fairing panel in the cockpit. Approximately 13 inches of cable travel is required to actuate the emergency system. Pulling the emergency control handle initiates action to unlock all gear uplocks, to unlock the hydraulically operated wheel door locks, to mechanically override the gear and door control valve, to open the landing gear emergency extension dump valve and to actuate the nose landing gear emergency extension selector valve to full emergency position. The mechanical override depresses the gear up and door closed solenoid-operated valve's override buttons to ensure that the valves have returned to their normal position to provide a return path for fluid. The emergency dump valve is opened to connect the gear-down and door-open lines to return, thereby preventing cavitation in the gear and door actuating cylinders. When the main gear uplocks are unlocked, the gear starts to free fall and contacts a bell crank on the strut door locking mechanism. The weight of the falling main gear unlocks the strut door and forces all doors to the open position. Air loads and gravity extend the main gear and the spring-loaded overcenter bungee forces the side brace overcenter; this permits the spring-loaded downlock pin to engage and lock the gear in the down position. When the nose gear uplock is unlocked and the emergency extension selector valve is actuated to the emergency position, emergency accumulator pressure is directed through the shuttle valve to the down side of the nose gear actuating

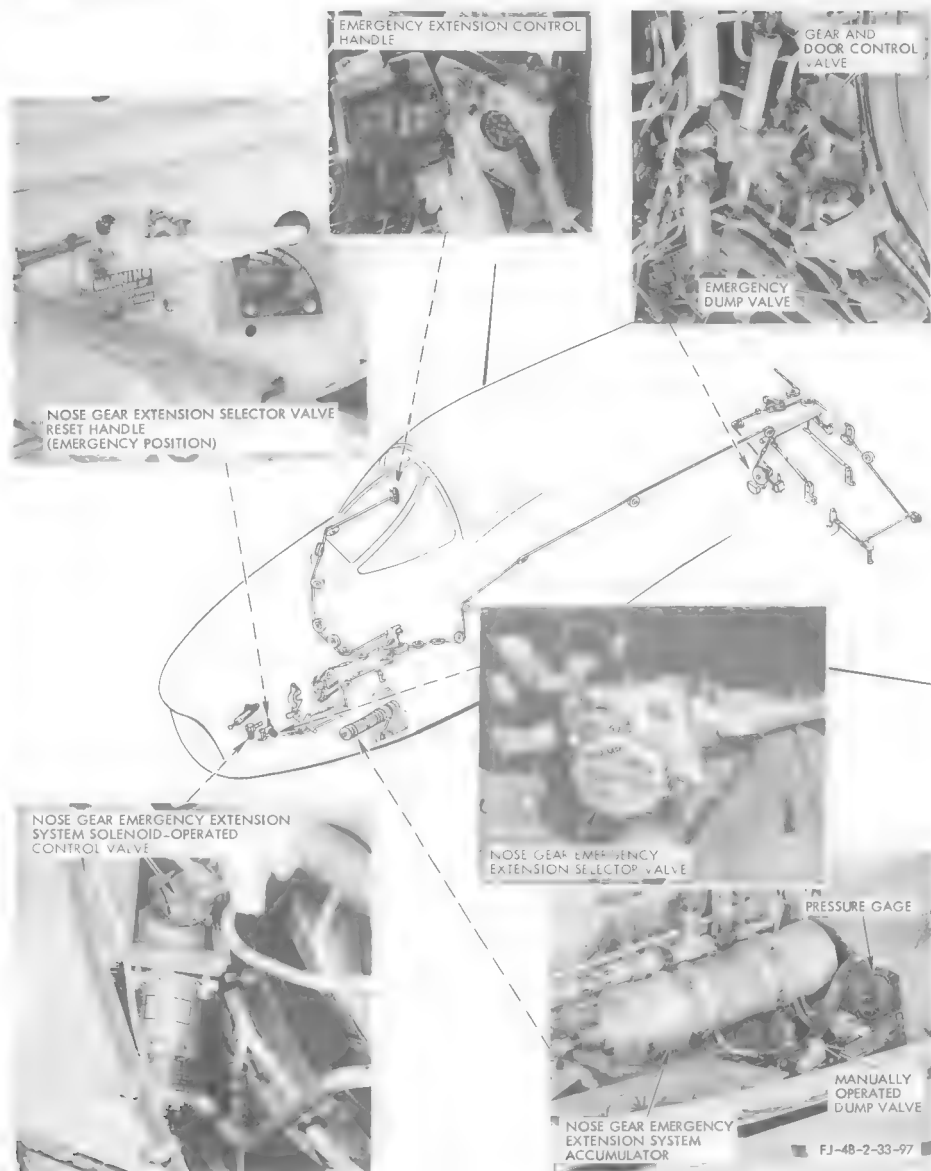


Figure No. 3-43. Landing Gear Emergency Extension System Unit Location

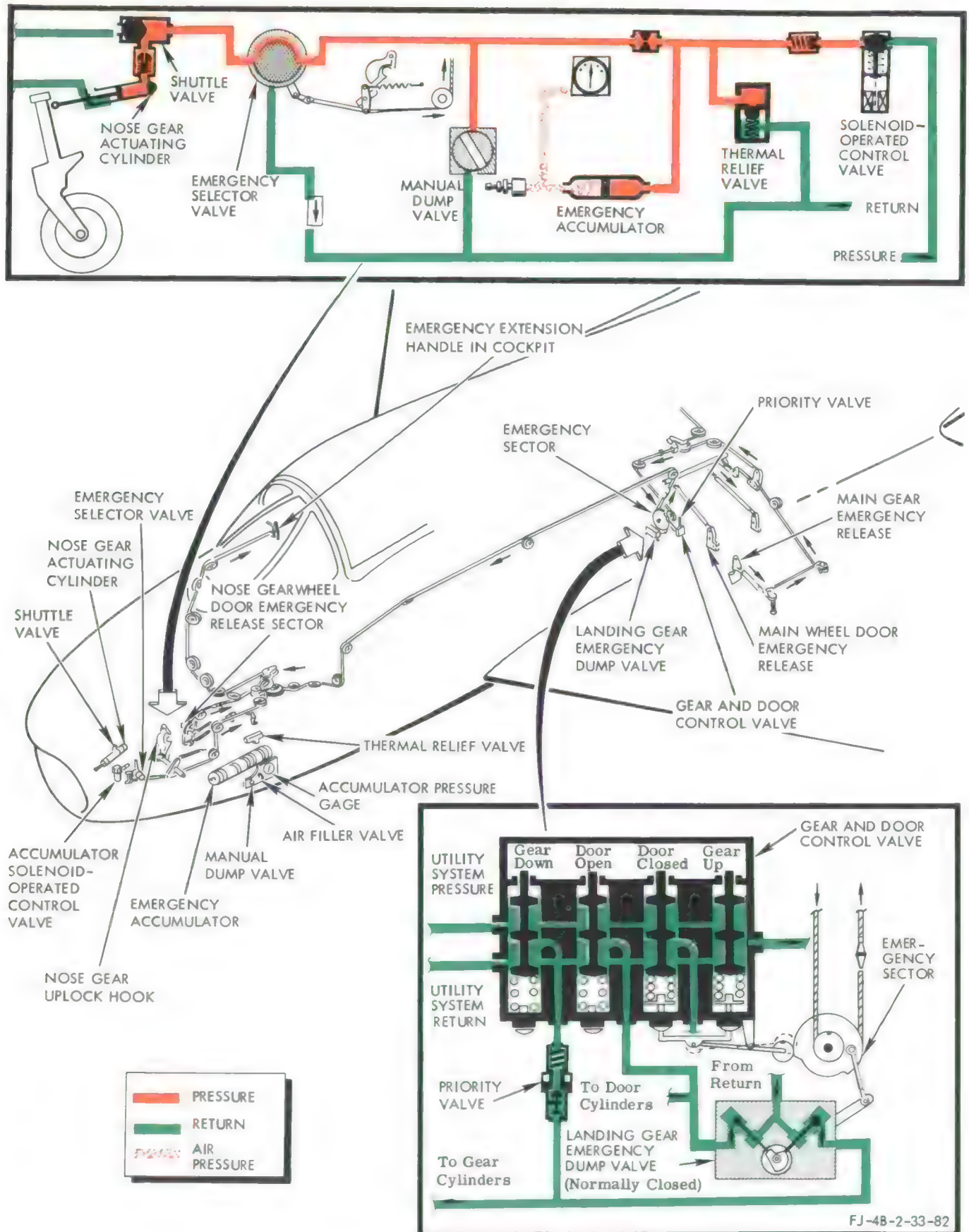


Figure No. 3-44. Landing Gear Emergency Extension Schematic

Section III  
Landing Gear System

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cylinder and extends the nose gear against the air stream to the down and locked position. After each emergency extension of the landing gears, it is necessary for the

ground crew to reset the nose gear emergency extension selector valve before the nose gear can be retracted. (See figure 3-44.)

3-197. TROUBLE SHOOTING LANDING GEAR EMERGENCY EXTENSION SYSTEM.

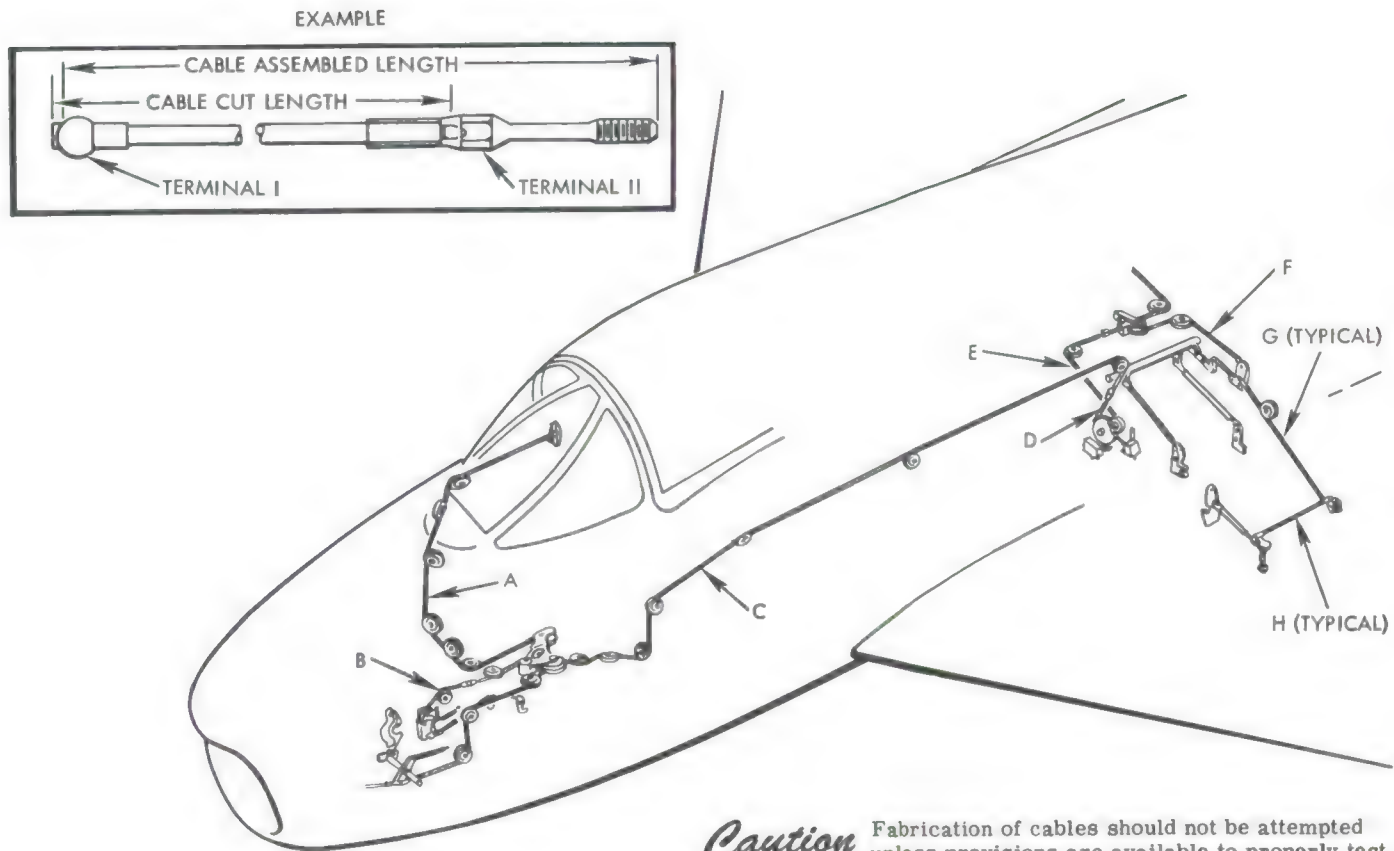
TEST EQUIPMENT: D-C voltmeter.

SYSTEM CONDITIONS: Weight of airplane on landing gear.  
28-volt d-c power applied to airplane.  
Hydraulic power connected to airplane.  
LG. & WING FOLD and GROUND SAFETY &  
OVERVOLTAGE circuit breakers engaged.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY	
NOSE GEAR "ONE SHOT" EMERGENCY EXTENSION SYSTEM WILL NOT CHARGE.				
Solenoid-operated control valve not operating due to one or a combination of the following:  a. Defective control valve.  b. Defective GROUND SAFETY RELAY NO. 1.  c. Defective wiring.	Check between test point GCA and ground.	28 volts dc.	Replace defective solenoid-operated control valve. (Refer to paragraph 3-204.)	
		Zero volts.	Continue trouble shooting.	
	Check between test point GJ and ground.	28 volts dc.	Replace defective GROUND SAFETY RELAY NO. 1 or wiring to solenoid-operated control valve.	
		Zero volts.	Replace defective wiring to GROUND SAFETY RELAY NO. 1.	
	Malfunction in ground safety circuit.	Check between test points GK and GL.  Note Test point GL is positive.	Zero volts.	No action.
			28 volts dc.	Properly adjust or replace defective ground safety switch. (Refer to paragraphs 3-116 and 3-117.)
ELECTRICAL POWER FAILURE.				
Defective circuit breaker.	Check between test point PDA and ground.	28 volts dc.	Replace circuit breaker.	
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.	
EMERGENCY EXTENSION HANDLE CANNOT BE PULLED OUT.				
Rig pin in emergency extension cable system.	Check all rig pin points. (Refer to paragraph 3-199.)		Remove rig pin.	



PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>PRESSURE IN NOSE GEAR "ONE SHOT" EMERGENCY EXTENSION SYSTEM LEAKS DOWN TO 1200 PSI (ACCUMULATOR PRECHARGE) WHEN NO HYDRAULIC POWER IS PRESENT. (Cont)</b>		
Nose gear emergency extension selector valve, manual dump valve or thermal relief valve by-passing fluid to return.	<p>Refer to paragraph 3-212 and check selector valve for proper adjustment.</p> <p>If pressure leaks down very rapidly, defective valve may be determined by pressurizing emergency extension system and disconnecting return line of respective valves.</p> <p>If pressure leaks down over an extended period of time and defective valve cannot be determined by disconnecting the return line, remove the respective valves from airplane and bench test as outlined in the following procedure.</p> <p>a. With emergency extension selector valve in normal position, apply 3000 psi at pressure port for 3 minutes. Leakage from return port shall not exceed 4 drops per minute.</p> <p>b. With manual dump valve in the normal position, apply 3000 psi at pressure port for 3 minutes. Leakage from return port shall not exceed 3 drops per minute.</p> <p>c. Apply pressure gradually to pressure port of thermal relief valve until valve cracks (approximately 4000 psi) and permits a steady stream of hydraulic fluid to flow from return port. Gradually decrease pressure to 3600 psi (reseal pressure) and wait 2 minutes to permit valve to reseal. After a 2-minute period, leakage from return port shall not exceed 10 drops per minute.</p>	<p>Properly adjust selector valve. (Refer to paragraph 3-199.)</p> <p>Replace defective valve.</p> <p>Replace defective valve.</p> <p>Replace defective valve.</p>
External leakage.	Visually check system.	Repair system leak.
<b>AFTER AN EMERGENCY EXTENSION OF THE LANDING GEARS HAS BEEN PULLED, THE NOSE GEAR WILL NOT RETRACT.</b>		
Emergency selector valve not reset to normal position.	Check emergency selector valve for correct position.	Reset valve.



**Caution** Fabrication of cables should not be attempted unless provisions are available to properly test assembled cables.

CODE	TERMINAL I					TERMINAL II
		CUT LENGTH (INCHES)	ASSEMBLED LENGTH (INCHES)	DIAMETER (INCHES)	TYPE	
A	RA2487-3 BALL	107-11/16	107-5/16 ( $\pm 1/8$ )	3/32	CARBON STEEL 7 x 7	AN664-C3 BALL AND 194-33719-2 CABLE FITTING
B	RA2487-3 BALL	12-5/8	12-1/4	3/32	CARBON STEEL 7 x 7	AN664-C3 BALL AND 194-33719-1 CABLE FITTING
C	RA2500-3 FORK AND AN664-C3 BALL	200-5/8	203-7/16	3/32	CARBON STEEL 7 x 7	AN669-S3 RH TERMINAL
D	AN664-C3 BALL	12-1/4	13-3/4	3/32	CARBON STEEL 7 x 7	AN669-S3 LH TERMINAL
E	AN664-C3 BALL	25-3/4	25-5/8	3/32	CARBON STEEL 7 x 7	AN664-C3 BALL
F	RA2482-3 EYE AND AN664-C3 BALL	36-7/16	39-1/4	3/32	CARBON STEEL 7 x 7	AN669-S3 RH TERMINAL
G	AN668-3 EYE	24-5/32	26-9/16 ( $\pm 1/8$ )	3/32	CARBON STEEL 7 x 7	AN666-3 RH TERMINAL
H	AN668-3 EYE	10-5/32	12-9/16 ( $\pm 1/8$ )	3/32	CARBON STEEL 7 x 7	AN666-3 RH TERMINAL

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Figure No. 3-45. Landing Gear Emergency Extension Control System Cable Fabrication Data

## 3-198. OPERATIONAL CHECK OF LANDING GEAR EMERGENCY EXTENSION SYSTEM.

- a. Place airplane on jacks. (Refer to paragraph 1-14.)
- b. Remove downlock safety pins from gear.
- c. Connect external power source to airplane.
- d. Connect hydraulic test stand to ground test connection panel and set to operate at 5.8 gpm pump output at 3000 psi.

**CAUTION**

When airplane is on jacks, make sure nose gear wheel is centered fore and aft before retracting landing gears or structural damage may result.

- e. Retract landing gear to the up and locked position.

**WARNING**

Make sure all personnel are clear of gears before operating.

- f. With the landing gear fully retracted and the nose gear emergency system fully charged, simulate an electrical failure by pulling out the LG & WING FOLD circuit breaker.

**Note**

Nose gear emergency extension accumulator can be charged when the weight of the airplane is off the gears by pulling the GROUND SAFETY & OVERVOLTAGE circuit breaker located on the left-hand radio bay circuit-breaker panel. After accumulator is charged, reposition circuit breaker in.

- g. With hydraulic power on, place the landing gear control handle to "DOWN" and pull out the emergency extension handle. The door locks should release and the main gear should fall within 30 degrees of the down position in less than 10 seconds. The nose gear should automatically extend and lock in less than 10 seconds.

**Note**

A force not to exceed 40 pounds at the main gear axle may be necessary to engage the main gear downlock pins.

- h. Reset the nose gear emergency selector valve to normal and recharge accumulator.

- i. Push in LG & WING FOLD circuit breaker. Check that emergency extension handle has returned to normal position.

- j. Place landing gear control handle to "UP" and fully retract gears.

- k. When landing gears are in the up and locked position, simulate a hydraulic power failure by shutting off test stand.

- l. With electrical power on, place the landing gear control handle to "DOWN" and pull out the emergency extension handle. The door locks should release and the main gears should fall within 30 degrees of the down position in less than 10 seconds. The nose gear should automatically extend and lock in less than 5 seconds.

**Note**

- A force not to exceed 40 pounds at the main gear axle may be necessary to engage the downlock pins.

- If, at the completion of the simulated electrical or hydraulic power failures, it is desired to close the hydraulically operated doors, it can be done by pushing in the LG & WING FOLD circuit breaker and adding hydraulic power. This can, in some cases, cause the doors to cycle. The cycling can be stopped by pulling the emergency release handle out again and releasing it in approximately 30 seconds.

- m. Reset the nose gear emergency selector valve to normal.

- n. Install landing gear downlock safety pins.

- o. Disconnect electrical power.

- p. Disconnect hydraulic test stand.

- q. Remove jacks from airplane.



### 3-199. RIGGING AND ADJUSTING LANDING GEAR EMERGENCY EXTENSION CONTROL SYSTEM.

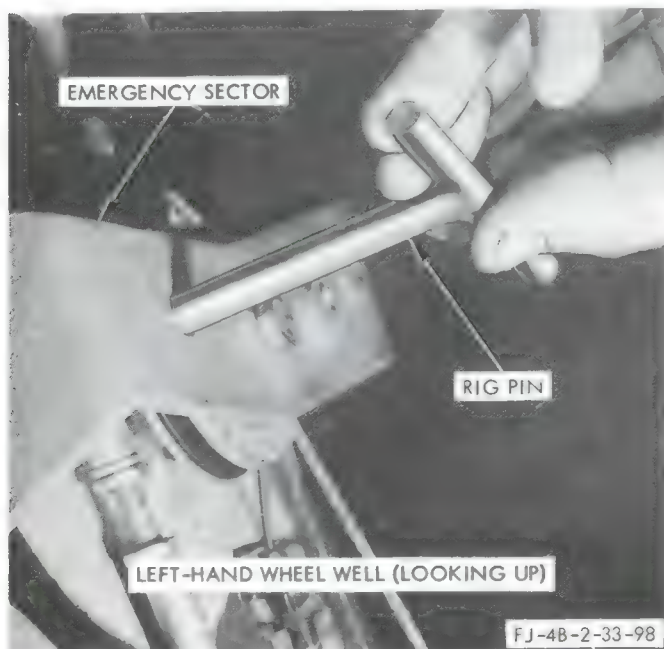
- 1** Open landing gear fairing doors. (Refer to paragraph 3-104.)

**Note** Prior to rigging landing gear emergency extension control system, all landing gear and fairing doors must be properly adjusted in the normal position.

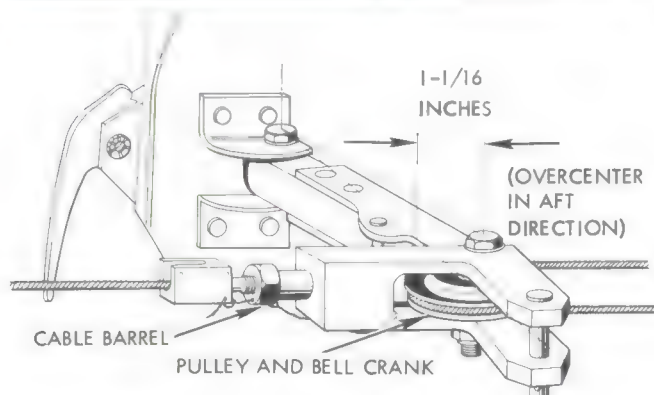
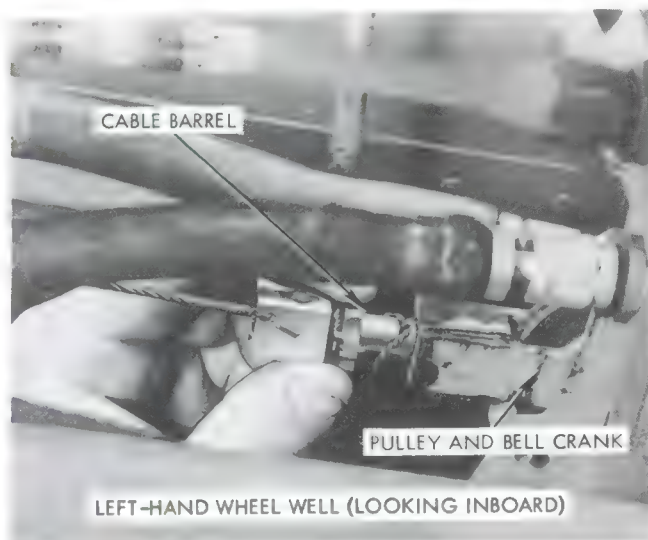
- 2** Set emergency release handle in cockpit to full in position.



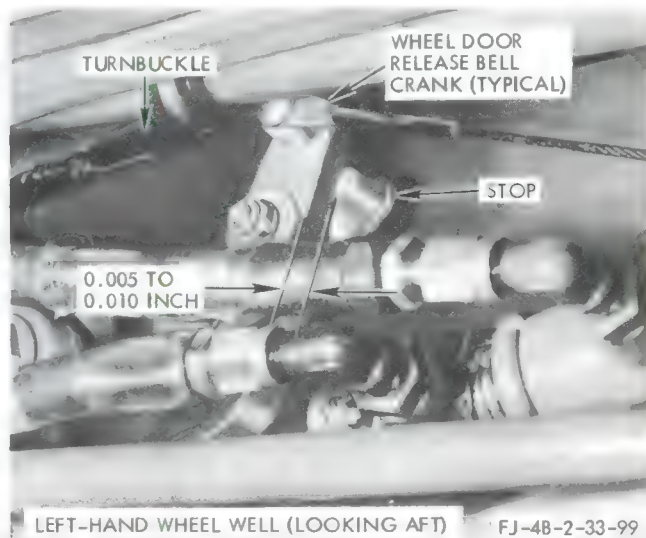
- 3** Insert 5/16-inch rig pin through sector and support on bulkhead 180 in forward engine bay.



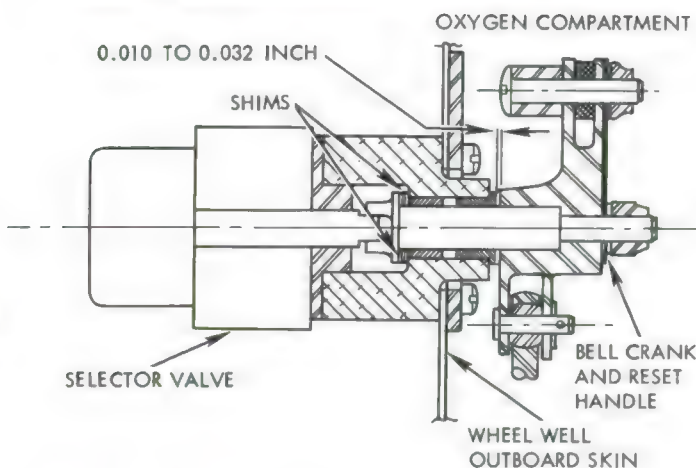
- 4** Adjust cable barrel located along lower center-line of airplane in main gear wheel well to position pulley center 1-1/16 inches aft of pulley bell crank attaching point.



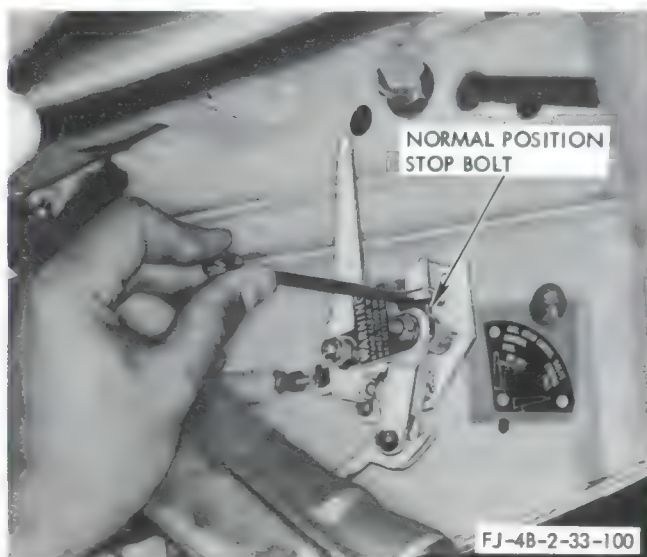
- 5** Adjust turnbuckle located along aft bulkhead of left-hand main gear wheel well until one, but not both, main gear wheel door release bell crank has pulled away from its stop 0.005 to 0.010 inch.



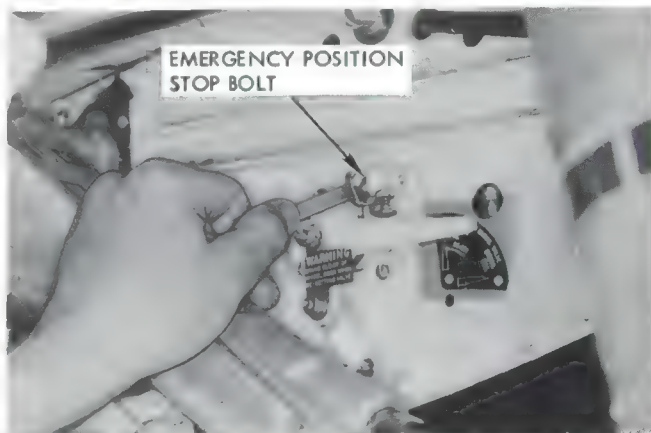
- 6** Check for a 0.010-to-0.032-inch clearance between emergency extension selector valve support and valve bell crank. To obtain this clearance, add or remove shims as required under emergency extension selector valve operating shaft.



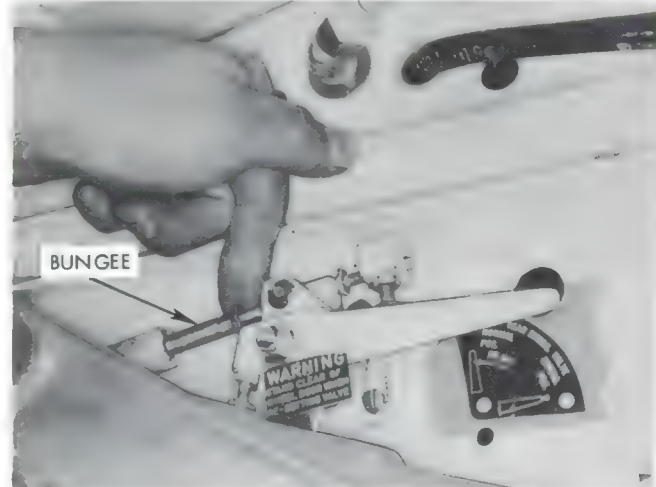
- 7** Rotate emergency extension selector valve reset handle counterclockwise to selector valve normal position detent. Adjust normal position stop bolt out until flush against bell crank. Unscrew stop bolt one complete turn and tighten locknut.



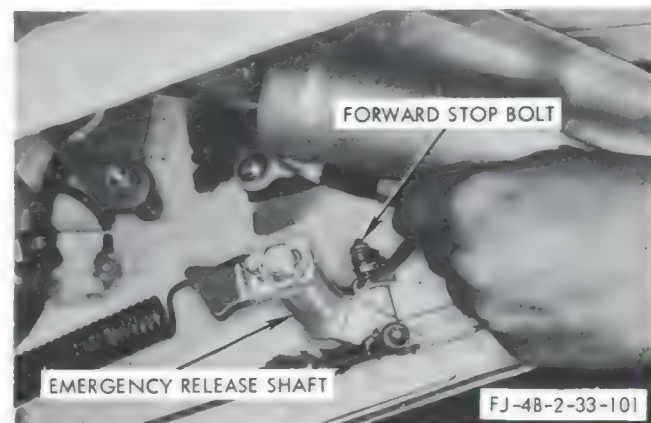
- 8** Rotate emergency extension selector valve reset handle clockwise to selector valve emergency position detent. Adjust emergency position stop bolt out until flush against bell crank. Unscrew stop bolt one complete turn and tighten locknut.



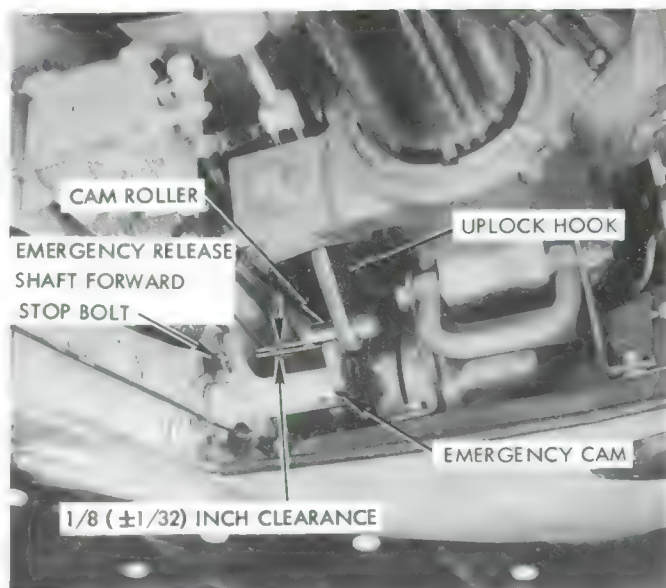
- 9** With emergency extension selector valve in emergency position against stop bolt, adjust free length of bungee to fit between attaching points. Lengthen bungee 4-1/2 turns at rod end and install.



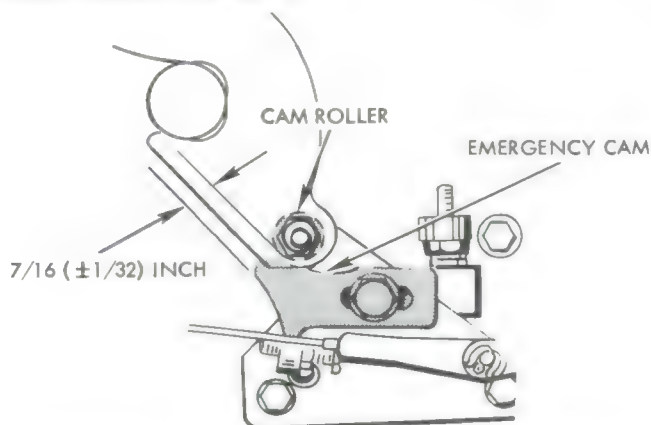
- 10** With the nose gear supported up and locked, and emergency selector valve in normal position, adjust nose gear emergency release shaft forward stop bolt to obtain 1/8 ( $\pm 1/32$ ) inch clearance between emergency cam and cam roller.



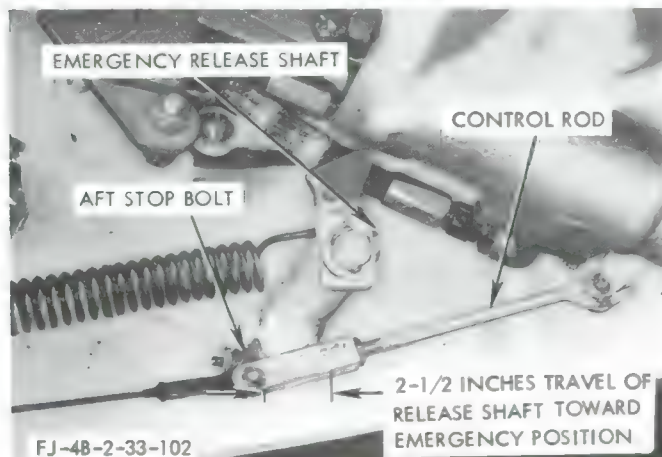




**11** Adjust nose gear emergency cam forward or aft on its serration to obtain a  $7/16$  ( $\pm 1/32$ ) inch cam-to-roller overlap, as shown.

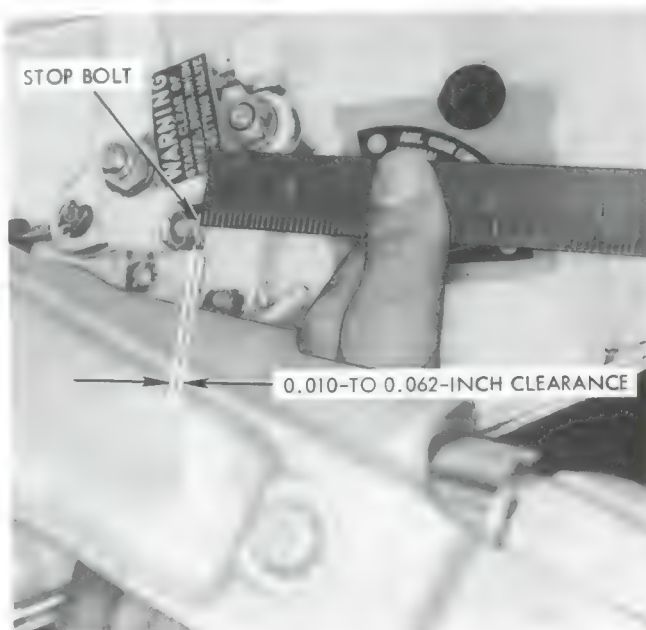


**12** With the nose gear in down and locked position, rotate emergency release shaft toward the emergency position until the control rod attach point on the emergency extension selector valve has traveled 2-1/2 inches as shown. Adjust emergency release shaft aft stop bolt flush against stop and tighten locknut.



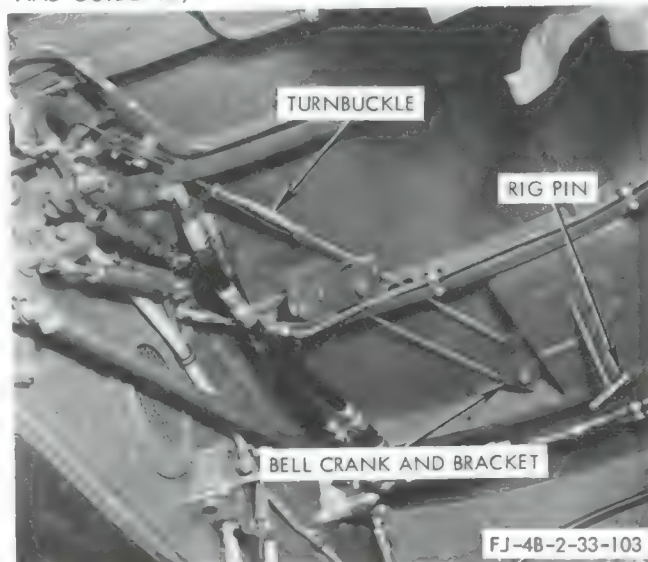
**13** With the selector valve in emergency position and the emergency release shaft against its aft stop (actuated) adjust emergency extension selector valve control rod to fit between attaching points. Shorten control rod one full turn and connect.

**14** With emergency reset handle in the normal position, adjust stop bolt on emergency extension selector valve bell crank to obtain from 0.010-to 0.062-inch clearance as shown.

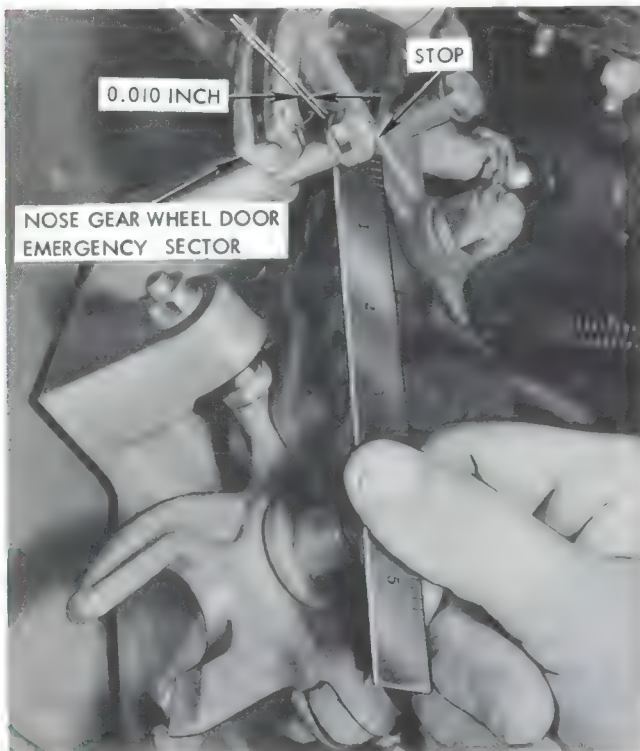


**15** Insert 5/16-inch rig pin through bell crank and bracket in nose landing gear wheel well.

RIGHT-HAND SIDE OF NOSE GEAR WHEEL WELL (LOOKING UP AND OUTBOARD)

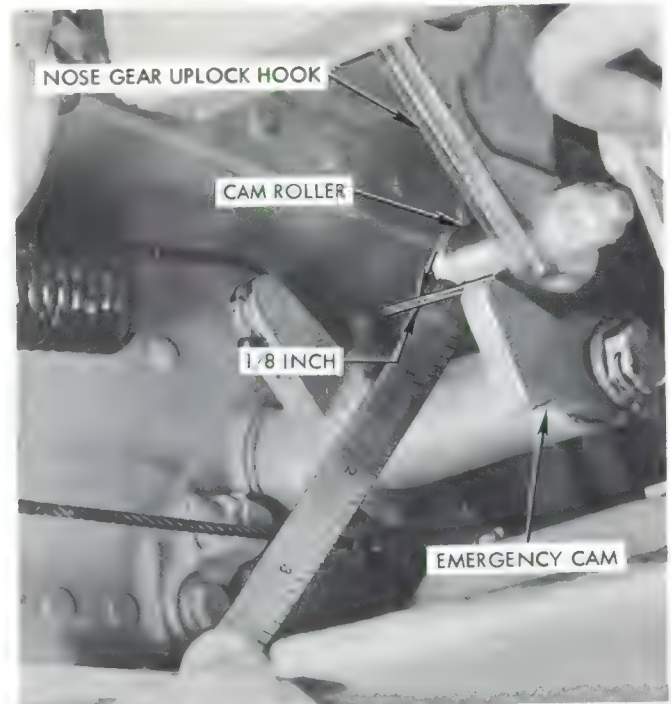
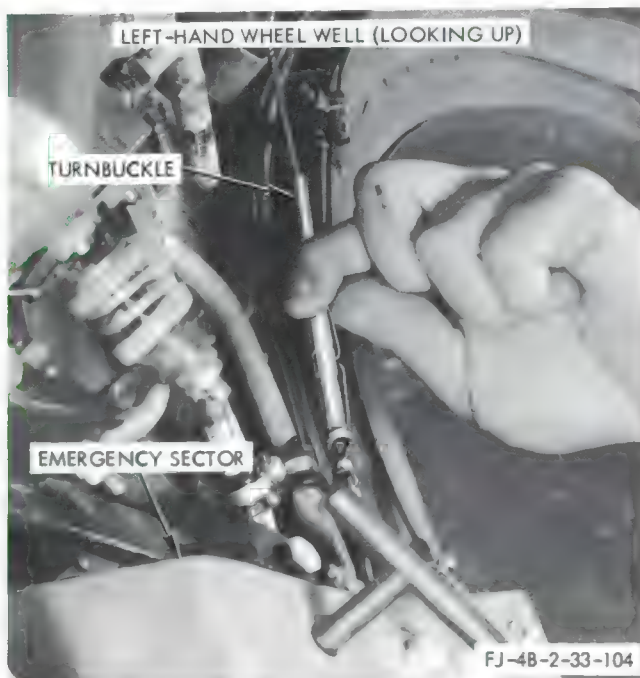


- 16** Adjust turnbuckle in nose gear wheel until nose gear wheel door emergency sector has pulled away from its stop 0.010 inch.



- 17** Adjust turnbuckle on bulkhead 180 in forward engine bay to obtain 1/8-inch clearance between nose gear emergency cam and roller when the nose gear is up and locked.

**Note** Rig pin of step 15 should be loose when accomplishing step 17.



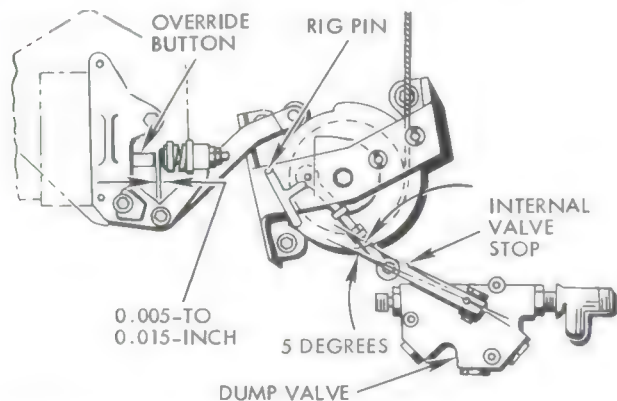
- 18** Rotate landing gear system emergency dump valve actuating arm clockwise until bottomed against valve's internal stop. From this position, rotate actuating arm counterclockwise 5 degrees. Adjust actuating rod to fit and install.

**Note** When properly adjusted, actuating rod length should be approximately 3-5/8 inches. Valve arm travel should be approximately 45 degrees counterclockwise.





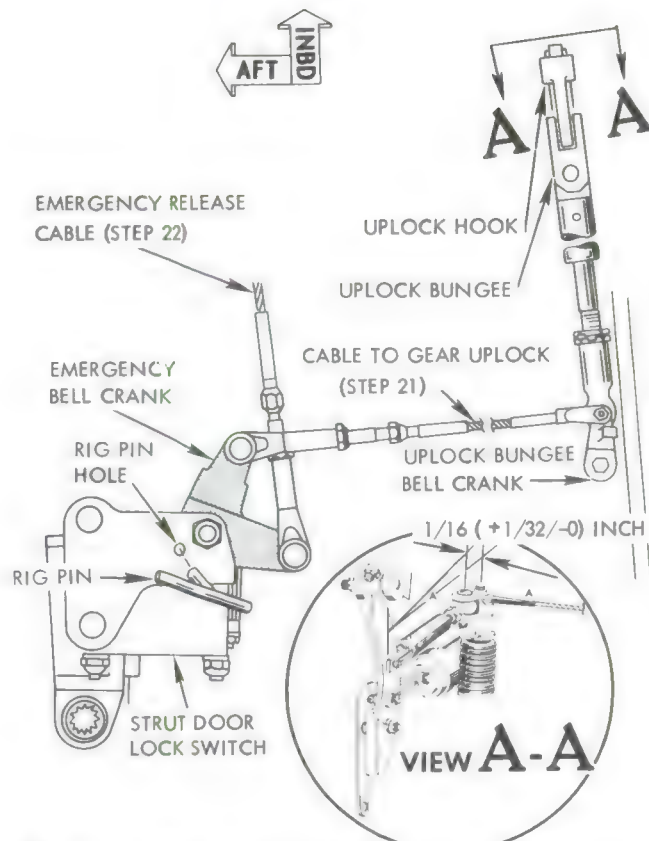
- 19** Adjust emergency extension manual override linkage to obtain from 0.005- to 0.015-inch clearance between linkage and override button on control valve.



- 20** Remove both rig pins and allow either main gear wheel door release bell crank or nose gear wheel door emergency release sector to return to its respective stop.

**Note** With rig pins removed, adjust turnbuckle of step 17, if necessary, to maintain a 1/8-inch maximum clearance between nose gear emergency cam and roller.

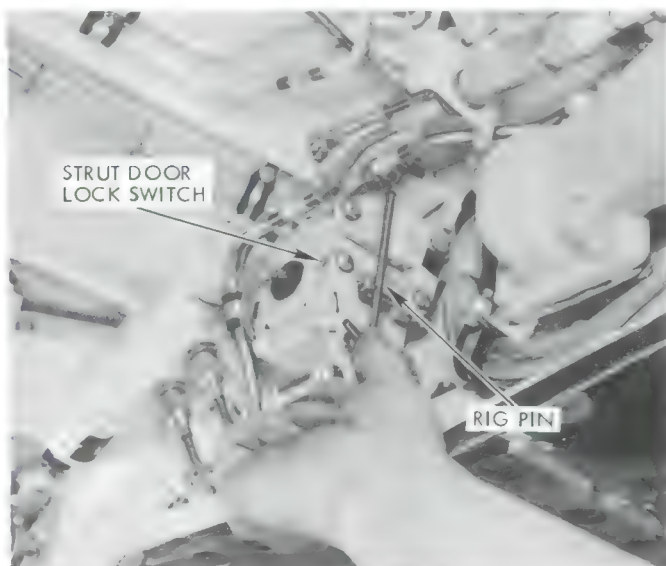
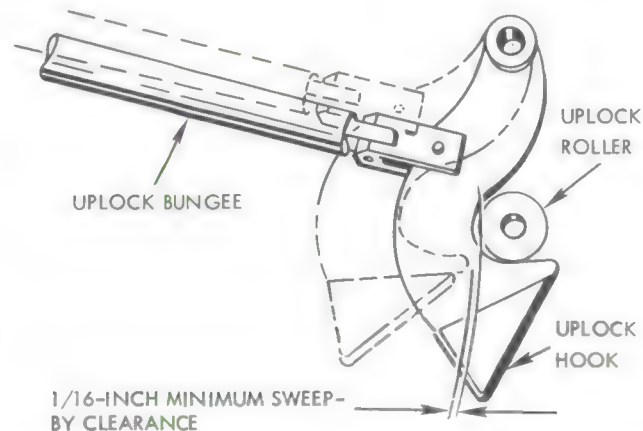
- 21** Insert a 3/16-inch rig pin through emergency bell crank and bell crank support directly above strut door lock roller in main gear strut well. Adjust emergency cable to main gear uplock hook to obtain a 1/16 (+1/32/-0) inch overcenter dimension between the uplock bungee and the uplock bungee bell crank as shown.



**Note** Rig pin must be able to be removed and reinserted after emergency cables of steps 21 and 22 have been rigged.

- 23** Maximum load required to actuate emergency release handle is 95 pounds.
- 24** Safety all turnbuckles with AN995F41 lockwire.
- 25** Check landing gear emergency extension system. (Refer to paragraph 3-198.)

**Note** Check for a 1/16-inch minimum sweepby clearance between main gear uplock roller and tip of uplock hook as shown. To obtain clearance, adjust turnbuckle referred to in step 5.



- 22** Adjust cable to emergency bell crank to balance out the load of main gear uplock emergency cable and remove rig pin.

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3-200. LANDING GEAR EMERGENCY EXTENSION SYSTEM DUMP VALVE. The landing gear emergency extension system dump valve is a three-port, poppet-type valve, rated at 3000 psi. It is located on the lower left-hand side of the forward bulkhead in the engine bay. When the dump valve is actuated, a free flow of hydraulic fluid is permitted from the return line to the gear-down and door-open lines to prevent cavitation in the gear and door cylinders. The dump valve is connected directly to the emergency sector in the engine bay by mechanical linkage.

#### 3-201. REMOVING LANDING GEAR EMERGENCY EXTENSION SYSTEM DUMP VALVE.

- a. Gain access to dump valve through access panel in left-hand main gear wheel well.
- b. Exhaust reservoir air pressure.
- c. Disconnect four hydraulic lines from valve and cap opening.
- d. Disconnect mechanical linkage from valve arm.
- e. Support valve and remove three bolts and washers attaching valve to bulkhead.
- f. Remove valve from airplane.

#### 3-202. INSTALLING LANDING GEAR EMERGENCY EXTENSION SYSTEM DUMP VALVE.

- a. Position valve to fit on bulkhead and install mounting bolts and washers.
- b. Remove caps and connect four hydraulic lines to dump valve.
- c. Insert rig pin through sector and support on bulkhead at station 180.906 in engine bay. Rotate valve arm clockwise until valve cam bottoms on internal stop. From this position, rotate valve arm 5 degrees in the counterclockwise direction. Adjust dump valve actuating rod to fit and install.

#### Note

When properly adjusted, actuating rod length should be approximately  $3\frac{5}{8}$  inches and valve arm travel should be approximately 45 degrees counterclockwise.

- d. Remove rig pin.
- e. Check landing gear emergency extension system. (Refer to paragraph 3-198.)

3-203. NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM SOLENOID-OPERATED CONTROL VALVE. The nose landing gear emergency extension system solenoid-operated control valve directs utility system hydraulic pressure to the nose gear emergency extension system when energized. The control valve is energized to the open position during all ground operations through ground safety relay No. 1. When the weight of the airplane is off the gears, the control valve is de-energized and returns to its normally closed position. The control valve is located on the left-hand side of the fuselage outboard of the nose gear well in the oxygen container compartment. Access to the control valve is gained through the oxygen access door.

#### 3-204. REMOVING NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM SOLENOID-OPERATED CONTROL VALVE.

- a. Exhaust pressure in nose gear emergency extension system.
- b. Disconnect two hydraulic lines from control valve and cap openings.
- c. Disconnect electrical plug from solenoid on valve.
- d. Support valve and remove two mounting bolts and washers attaching valve to bracket.
- e. Remove control valve from airplane.

#### 3-205. INSTALLING NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM SOLENOID-OPERATED CONTROL VALVE.

- a. Position control valve on mounting bracket so arrow on check valve is pointing aft.
- b. Install two mounting bolts and washers attaching valve to mounting bracket.
- c. Remove caps and connect two hydraulic lines to control valve.
- d. Connect electrical plug to solenoid on valve.
- e. Pressurize utility hydraulic system to charge nose gear emergency system and check valve for operation by observing emergency pressure gage. Pressure should build up and stabilize at 3000 psi.

3-206. NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM ACCUMULATOR. The nose landing gear emergency system accumulator stores hydraulic fluid under pressure to extend the nose gear in the event of an electrical or hydraulic failure. The accumulator is located on the left-hand side of the fuselage outboard of the nose gear well in the oxygen container compartment. The accumulator is composed of a steel cylinder and a floating piston and is precharged with 1200( $\pm$ 50) psi of compressed air. Hydraulic fluid enters the accumulator under 3000 psi from the utility hydraulic power system and moves the piston to compress the precharge to 3000 psi. The normally closed solenoid-operated control valve and a check valve, installed in the line between the utility hydraulic power system and the accumulator, trap and hold the pressurized fluid until the supply is used for emergency extension of the gear or is manually dumped into the utility hydraulic power system return. A direct reading pressure gage is connected to the accumulator to indicate air precharge and emergency extension system pressure. Access to the accumulator is gained through the oxygen access door.

#### Note

- During ground operation of the hydraulic system, pressure surges may be trapped in the accumulator. Pressure up to 4000 psi is acceptable.
- Pressures specified are actual system pressures and do not include accumulator gage error; therefore, the accuracy of the accumulator gage should be known. Maximum allowable pressure gage error is  $\pm$ 150 psi.

3-207. SERVICING NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM ACCUMULATOR. Refer to paragraph 1-44.



### 3-208. REMOVING NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM ACCUMULATOR.

- a. Dump emergency extension pressure by operating manual dump valve.
- b. Remove oxygen container. (Refer to paragraph 4-126.)
- c. Disconnect one air line and four hydraulic lines from accumulator and cap openings.

#### Note

A check valve and hydraulic fittings prevent the hydraulic lines from being disconnected at the accumulator. The check valve and fittings must be removed with the accumulator.

- d. Remove clamp from check valve.
- e. Support accumulator and remove nuts and washers attaching accumulator mounting straps together.
- f. Remove accumulator from airplane.

### 3-209. INSTALLING NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM ACCUMULATOR.

- a. Position accumulator to fit on mounting support; install nuts and washers attaching mounting straps together and partially tighten.
- b. Remove caps and connect one air line and four hydraulic lines to accumulator.
- c. Install clamp on check valve.
- d. Tighten nuts attaching mounting straps together.
- e. Install oxygen container. (Refer to paragraph 4-126.)
- f. Service accumulator. (Refer to paragraph 1-44.)

3-210. NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM MANUALLY OPERATED DUMP VALVE. The nose landing gear emergency system manually operated dump valve provides a means for manually dumping the nose gear emergency system prior to maintaining or servicing the system. The valve is located on a panel in the lower aft end of the oxygen container compartment. The valve is a two-way, two-port unit and is spring-loaded to the closed position. The handle of the valve must be rotated clockwise and held when nose gear emergency accumulator fluid is to be dumped back into the utility hydraulic power system return line.

3-211. NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM MANUALLY OPERATED SELECTOR VALVE. The nose landing gear emergency extension system manually operated selector valve is a three-port, two-position, rotary-type selector valve. It is located at the forward inboard corner of the oxygen container compartment on the left-hand side of the forward fuselage. The valve is manually actuated to the full emergency position by the emergency extension control system. When actuated to the emergency position, the

valve directs hydraulic pressure from the emergency extension system accumulator through the shuttle valve to extend the nose gear down and locked. In the normal position, the valve traps accumulator pressure and ports the shuttle valve hydraulic line to return. After an emergency extension of the landing gears, the selector valve must be reset to the normal position. Failure to reset the valve will prevent retraction of the nose gear on subsequent operation because accumulator pressure remains connected to the down port on the actuating cylinder.

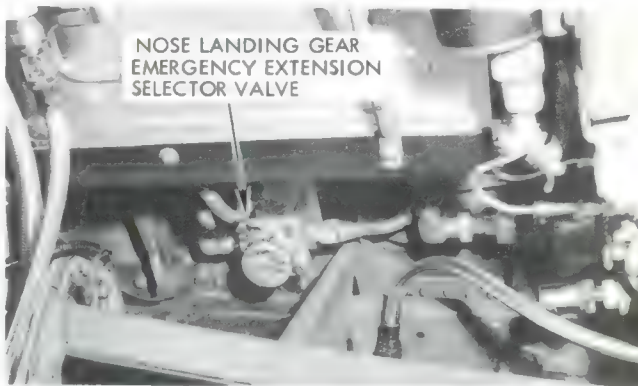
#### Note

To reset the nose landing gear emergency extension selector valve to normal, rotate the selector valve bell crank, located on the forward left-hand side of the nose gear wheel well, counterclockwise to the extreme aft position.

### WARNING

When resetting selector valve to the normal position, make sure no hydraulic power is present and keep clear of nose gear wheel door. Door might close unexpectedly and injure personnel.

### 3-212. REMOVING AND INSTALLING NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM MANUALLY OPERATED SELECTOR VALVE.



OXYGEN CYLINDER COMPARTMENT (LOOKING INBOARD)

#### REMOVING

- 1 Gain access to manually operated selector valve through oxygen cylinder access door.
- 2 Exhaust hydraulic pressure in nose landing gear emergency extension system.
- 3 Remove three hydraulic lines from selector valve and cap openings.
- 4 Gain access to selector valve mounting screws through nose gear wheel well.
- 5 Remove four screws securing selector valve and collar to support.
- 6 Remove selector valve and collar from airplane.

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## INSTALLING

- 1 Position selector valve and collar to fit on support so valve port stamped "CYL." is on top. Valve port stamped "RET." should be pointing aft.

**Note** Make sure valve shaft is in the correct position to correspond with position of reset handle shaft before engaging. If positions of two shafts do not correspond, operation of valve will be reversed.

- 2 Install four screws securing selector valve and collar to support. Safety with lockwire.
- 3 Remove caps and connect three hydraulic lines to selector valve.
- 4 Check landing gear emergency extension system. (Refer to paragraph 3-198.)

**Note** If manually operated selector valve does not meet normal requirements, refer to paragraph 3-199 and adjust.

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3-213. NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM THERMAL RELIEF VALVE. Excessive pressure, due to thermal expansion or pressure surges in the nose gear emergency system, is prevented by the thermal relief valve. The thermal relief valve, located in the oxygen container compartment on the left-hand side of the fuselage, is set to crack at 4000 psi.

3-214. NOSE LANDING GEAR EMERGENCY EXTENSION SYSTEM SHUTTLE VALVE. The shuttle valve is installed in the nose gear down line to separate the normal and emergency system. The shuttle valve contains a sliding piston that is positioned by the dominating pressure of either the normal or emergency system. The shuttle valve is located on the nose landing gear actuating cylinder.

3-215. NOSE LANDING GEAR "ONE SHOT" EMERGENCY EXTENSION SYSTEM LEAKAGE CHECK. The nose landing gear "one shot" emergency extension system should be checked for excessive leakage periodically or any time the system is suspected of leaking as outlined in the following procedure:

- a. Service nose gear emergency extension accumulator with 1200 ( $\pm 50$ ) psi dry air. (Refer to paragraph 1-44.)

**Note**

Make sure the accumulator does not leak internally. (Refer to paragraph 3-197.)

- b. Connect external electrical power source to airplane.
- c. Connect hydraulic power source to ground test connection panel and set to operate at 5.8 gpm at 3000 psi.
- d. Push in GROUND SAFETY & OVERVOLTAGE circuit breaker and permit emergency extension system to charge to 3000 psi. Pull circuit breaker and operate manual dump valve.

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**Note**

Repeat step d. at least twice to ensure that the system is purged of air.

- e. Recharge the nose gear emergency extension system to 3000 psi, pull the circuit breaker and permit the pressure to stabilize.

**Note**

Repeat step e. at least twice to ensure that temperature has stabilized.

- f. With the emergency extension system fully charged, disconnect external electrical and hydraulic power sources from airplane.

- g. Wait for a period of 30 minutes and check pressure gage reading on emergency extension panel. Pressure should not have dropped more than 50 psi in the first 30 minutes. If pressure drops more than 50 psi in given period, the emergency extension system contains a defective unit that must be repaired or replaced before the system can be considered satisfactory.

**Note**

- If pressure does not exceed the 50 psi maximum and the system is still suspected of excess leakage, wait for 8 hours and check pressure gage. At the end of given period, pressure should not have dropped more than 600 psi.
- Pressures specified are actual system pressures and do not include accumulator gage error; therefore, the accuracy of the accumulator gage should be known. Maximum allowable pressure gage error is  $\pm 150$  psi.

- h. If the nose gear emergency extension system is not considered satisfactory, check for a defective unit as outlined in paragraph 3-197.

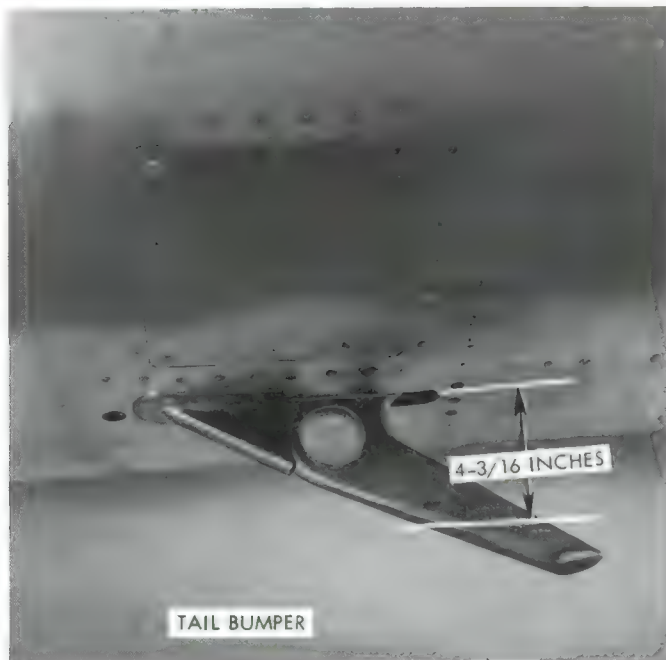
## 3-216. TAIL BUMPER.

3-217. The tail bumper is a forged steel skid that protrudes below the mold line of the aft fuselage. It is located at the lower centerline of the aft fuselage. A friction clutch is incorporated in the tail bumper to sustain loads up to a maximum of 7000 pounds. Any applied load that does not exceed the 7000-pound maximum is carried on the tail skid and prevents damage to the aft section of the fuselage and tail pipe. Normally, there is no maintenance or adjustment required for the tail bumper installation. If the tail bumper is struck hard enough on landing to rotate the unit, it must be reset by the ground crew.

**CAUTION**

At no time should any lubricants be used on the friction clutch.

3-218. RESETTING TAIL BUMPER.



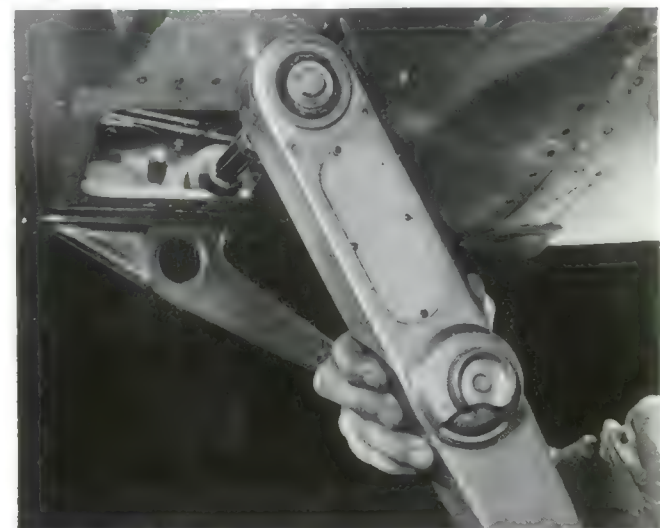
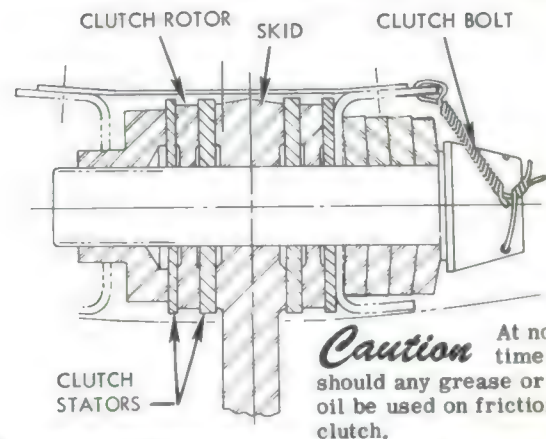
**Note** Replace tail bumper when it wears to dimension shown.

- 1** Remove access door on left side of aft fuselage adjacent to the tail bumper.



- 2** Break safety wire and loosen tail bumper clutch bolt. Rotate tail bumper forward until it is reset against its stop.

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- 3** Torque clutch bolt to 300 ( $\pm 10$ ) foot-pounds and safety with lockwire (AN995F47).

- 4** Replace access panel.

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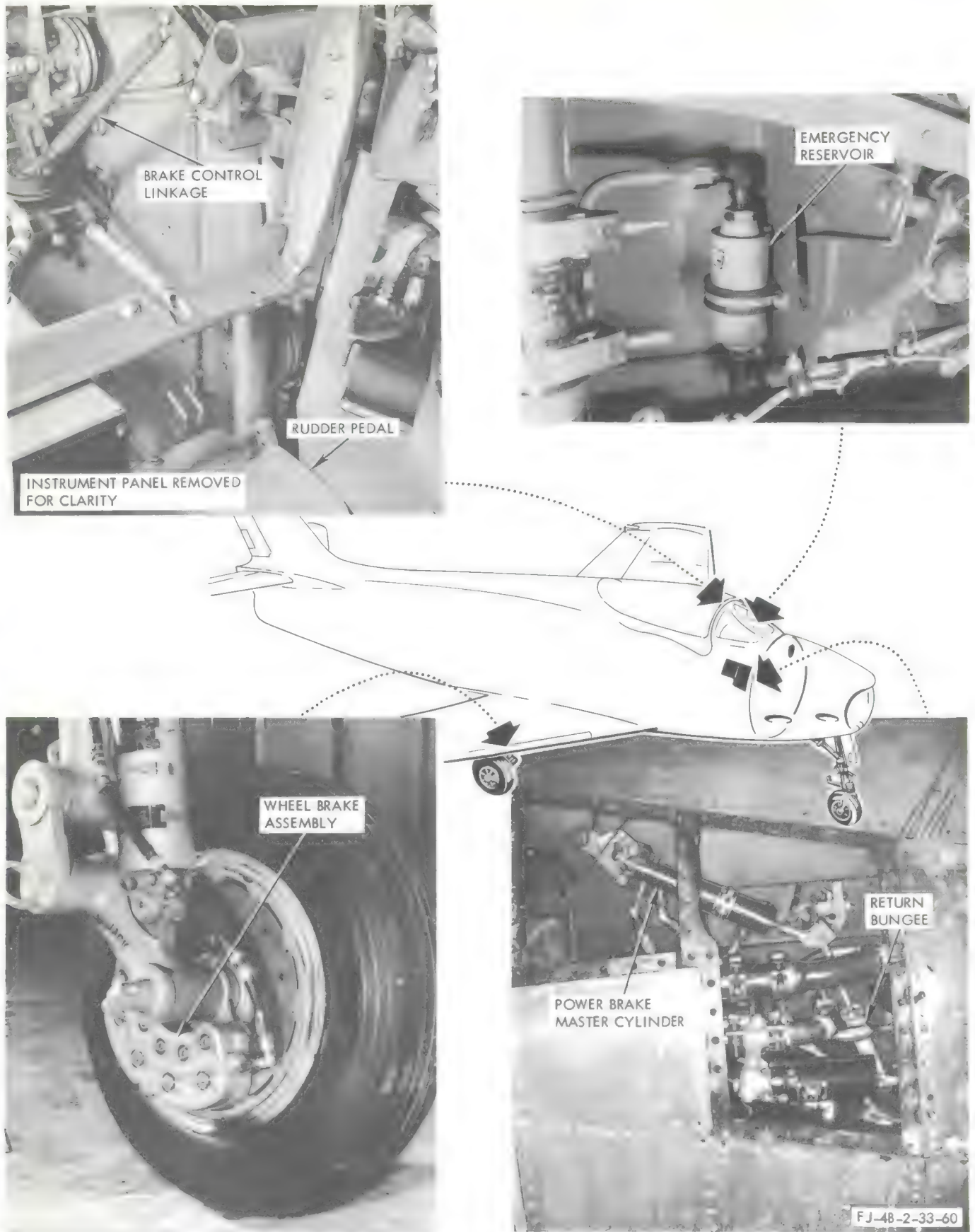


Figure No. 3-46. Wheel Brake System Unit Location

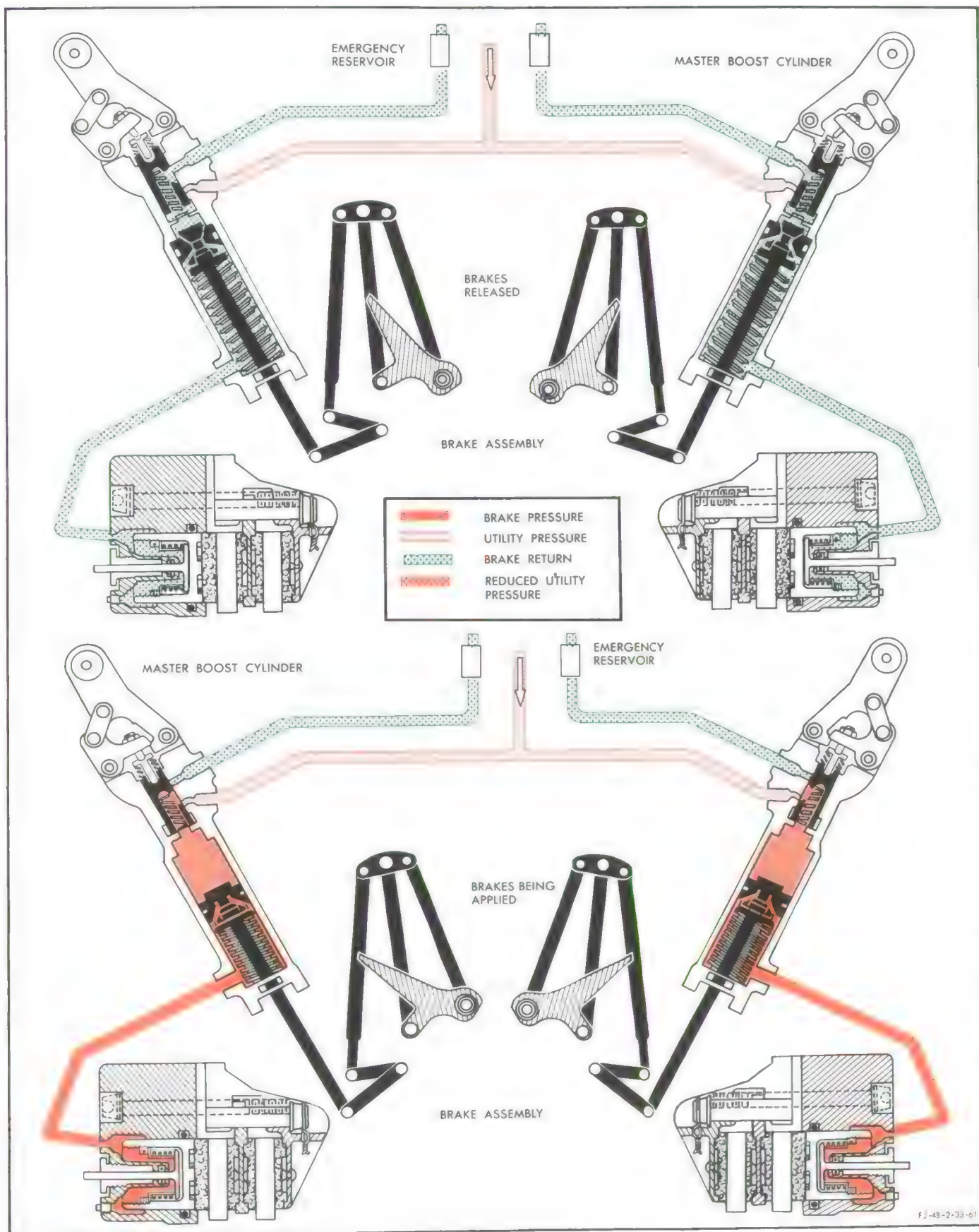


Figure No. 3-47. Wheel Brake System Schematic

**WHEEL BRAKE SYSTEM****3-219. WHEEL BRAKE SYSTEM.**

3-220. The main landing gear wheel brake system (figure 3-46) is a power boost-type system consisting of a dual disk-type brake assembly at each wheel, a power boost master brake cylinder to regulate pressure to each brake assembly, a bungee to return each master brake cylinder to off and an emergency brake reservoir to retain enough hydraulic fluid for manual operation of the brakes in the event no hydraulic power is present. The rudder pedals, through mechanical linkage, actuate the master brake cylinder. A priority valve, installed in the utility hydraulic power system pressure line, ensures sufficient brake system hydraulic pressure in the event of low-pressure output or excessive by-passing of fluid downstream of the priority valve during utility system operation. A line-type filter is installed in the brake system return line to filter the hydraulic fluid before it enters the utility hydraulic system reservoir.

**3-221. FUNCTION OF WHEEL BRAKE SYSTEM.**

3-222. Pilot effort applied to the rudder pedal is transmitted through mechanical linkage to actuate the corresponding power boost master brake cylinder. When the master brake cylinder is actuated, it regulates the 3000 psi from the utility hydraulic power system so that approximately 750 ( $\pm 25$ ) psi is applied to the brake assembly at the wheel. As hydraulic pressure is introduced to the brake assembly, the self-adjusting pistons

are forced out to compress the brake lining and rotating disks together. The friction developed between the brake linings and the rotating disks results in an effective wheel braking action. When the brakes are applied and held, there is a no-flow condition through the master cylinder as long as pressure in the lower brake lines is sufficient to hold the brake assembly fully engaged. Hydraulic pressure builds up in the master cylinder, forcing the sliding control valve to close off the pressure and return port, thus accomplishing this no-flow condition and preventing pressure in the lower brake lines from becoming excessive. The amount of boost pressure to the brake assemblies increases with the force transmitted to the master cylinder, but the pressure reaches maximum (750 psi) when the master cylinder toggle linkage is against its stop. Increased force at the rudder pedals beyond this point produces higher brake pressure at the wheels but has no effect on boost pressure. When the rudder pedals are released (brakes off), the return bungee aids in returning the master cylinder to off, thus providing a return path for hydraulic fluid trapped in the boost chamber of the master cylinder. The brake piston return springs disengage the brake pistons and force the hydraulic fluid in the lower brake lines back to the master brake cylinder. Boost fluid is returned to the utility system reservoir through the brake system return line. The return fluid is filtered prior to entering the reservoir. (See figure 3-47.)

**3-223. TROUBLE SHOOTING WHEEL BRAKE SYSTEM.**

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>BRAKE ACTION UNEVEN WITH APPLICATION OF EQUAL PEDAL PRESSURE.</b>		
Tire pressure incorrect.	Check tires for proper inflation.	Correct tire pressure. (Refer to paragraph 1-46.)
Brake system control linkage improperly adjusted.	Check adjustment of brake control linkage. (Refer to paragraph 3-249.)	Adjust brake linkage. (Refer to paragraph 3-249.)
Oil or foreign matter on brake lining.	Disassemble brake and check condition of lining.	Clean or replace linings.
Master brake cylinder improperly adjusted or defective.	Check wheel brake system. (Refer to paragraph 3-224.)	Properly adjust or replace master brake cylinder. (Refer to paragraph 3-249.)
<b>BRAKES DRAG OR DO NOT RELEASE.</b>		
Improperly torqued gland nut.	Visually check automatic adjusting pins.	Reset automatic adjusting pins and properly torque gland nuts.
Excessive friction in brake system control linkage.	Check control linkage for broken or binding parts that would prevent master cylinder from returning to off.	Replace broken or binding linkage.
Master brake cylinder flex hose improperly installed.	Examine flex hose travel while actuating pedal.	Install flex hose correctly to provide proper flexing.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>BRAKES DRAG OR DO NOT RELEASE. (Cont)</b>		
Brake system control linkage improperly adjusted.	Check adjustment of brake control linkage. (Refer to paragraph 3-249.)	Properly rig control linkage. (Refer to paragraph 3-249.)
Brake return filter dirty or clogged.	Check for pressure at brake assemblies with engine running and brakes released. Pressure should not exceed 15 psi.	Replace brake filter element. (Refer to paragraph 3-52.) <b>Note</b> The cleanliness of the brake filter element cannot be determined by visual inspection. Any time the brake filter is removed as a result of dragging brakes, it must be replaced.
Defective air pressure regulator in utility hydraulic power system.	Check utility hydraulic power system for correct air pressure.	Replace defective air pressure regulator.
Rotating disks on brake assembly warped.	Disassemble brake assembly and visually check for warpage.	Replace rotating disk.
Brake pistons dirty or corroded.	Disassemble brake assembly and check pistons for condition.	Clean or replace brake pistons.
Brake piston return spring set or broken.	Visually check piston for a positive return when brakes are being applied and released.	Replace defective piston.
Brake master cylinder defective.	Check for pressure at brake assemblies with the engine running and brakes released. Pressure should not exceed 15 psi.	Replace master cylinder.
<b>BRAKES GRAB.</b>		
Grease or oil on brake lining.	Disassemble brake assembly and visually check brake linings.	Clean or replace brake linings.
<b>STEADY LOSS OF PEDAL PRESSURE WHEN BRAKES ARE APPLIED.</b>		
Brake master cylinder leaking internally.	Attach pressure gage to bleeder fitting on brake assembly at wheel. Pressurize brake system and apply brakes. With brakes applied and held, the reading on the pressure gage should stabilize. If pressure keeps dropping and building up, brake master cylinder is leaking internally.	Replace defective master cylinder.
External leak in brake system.	Visually check all components and lines of brake system for external leakage.	Repair system leak.
<b>INSUFFICIENT BRAKING.</b>		
Utility hydraulic system pressure too low.	Refer to paragraph 3-7.	



PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>INSUFFICIENT BRAKING. (Cont)</b>		
Brake linings worn.	Check brakes for wear. (Refer to paragraph 3-248.)	Replace brake linings. (Refer to paragraph 3-248.)
Air in brake system.	Apply brakes and determine if a soft or spongy action can be felt through the rudder pedals.	Bleed brakes. (Refer to paragraph 3-226.)

3-224. OPERATIONAL CHECK OF  
WHEEL BRAKE SYSTEM.

3-225. To check wheel brake system, proceed as follows:

**Note**

Make sure brake system is free of air. Perform checks in sequence outlined and correct any noted discrepancies. If operational check does not meet normal requirements, refer to paragraph 3-223.

a. Remove dust screw and connect a hydraulic pressure gage calibrated for 1000 psi to the bleeder port on each brake assembly.

b. Connect a hydraulic test stand to the ground test connection panel and set to operate at 3000 psi with a pump output of 2.1 gpm.

c. Gradually depress rudder pedals; a pressure build-up should be observed on pressure gages at brake assemblies when a maximum of 20 pounds force is applied to the rudder pedals to indicate boost pressure.

**Note**

If foot force is not applied gradually to the rudder pedals, it will be possible to get a high boost pressure at the brake assemblies due to friction in the master cylinder and linkages.

d. Gradually depress rudder pedal until approximately 60 to 65 pounds force is applied. Pressure gages at the brake assemblies must read at least 275 psi.

e. Apply equal forces to the right- and left-hand rudder pedals; brake pressures at the assemblies must be within 50 psi of each other.



f. Exhaust hydraulic pressure and disconnect test stand from airplane.

g. Remove pressure gages from bleeder port and install dust screw.

h. Service utility hydraulic system reservoir. (Refer to paragraph 3-8.)

### 3-226. BLEEDING WHEEL BRAKE SYSTEM.

3-227. To bleed wheel brake system, proceed as follows:

a. Remove dust screw from bleeder fitting and connect a bleeder hose to bleeder port on brake assembly.

b. Place the open end of the bleeder hose in a clean container of hydraulic fluid so that air bubbles can be observed.

c. Connect a hydraulic test stand to ground test connection panel and set to operate at 3000 psi with approximately 2 gpm pump output.

d. Open bleeder fitting one to two full turns and depress respective rudder pedal enough to obtain a continuous flow of hydraulic fluid from the bleeder port.

e. Bleed brakes until fluid from bleeder port is free of air and a minimum of 2 quarts of hydraulic fluid is bled from system.

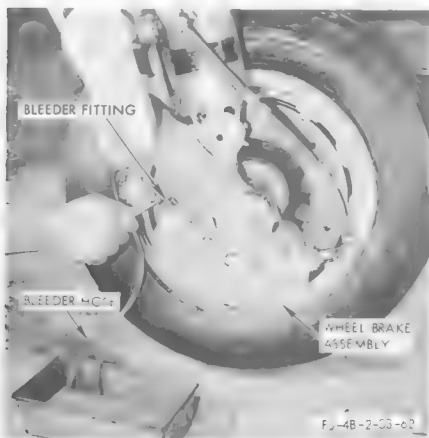


Figure No. 3-48. Bleeding Wheel Brake System

#### CAUTION

Excessive bleeding can exhaust the supply of hydraulic fluid in the utility hydraulic power system reservoir and cavitate the test stand pump.

f. When bleeding is completed, close bleeder fitting, remove bleeder hose and install dust screw in bleeder fitting.

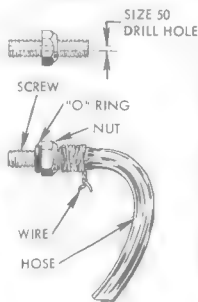
g. Exhaust hydraulic pressure and disconnect test stand.

h. Service utility hydraulic power system reservoir. (Refer to paragraph 3-8.)

### 3-227A. FABRICATION OF WHEEL BRAKE SYSTEM BLEEDER HOSE. See figure 3-48A.

#### BILL OF MATERIAL

- (A) 1032 SCREW 1 INCH LONG
- (B) AN645-1032 LOCKNUT
- (C) AN6227-3 "O" RING
- (D) 30 INCHES OF 3/16-INCH I.D. NEOPRENE HOSE OR CLEAR SPAGHETTI



1 Install nut approximately halfway up on screw and saw off screw head.

2 Secure screw and nut in drill press and use size 50 drill to drill hole the length of the screw.

3 Install "O" ring against nut and secure hose or spaghetti with safety wire.

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Figure No. 3-48A. Fabrication of Wheel Brake System Bleeder Hose

### 3-228. WHEEL BRAKE SYSTEM PRIORITY VALVE.

3-229. Refer to paragraph 3-42.

### 3-230. WHEEL BRAKE SYSTEM POWER MASTER CYLINDER.

3-231. The power boost-type master cylinders regulate hydraulic pressure to the brake assemblies. They are located outboard of and are attached to the rudder pedal by linkages. Access to the master cylinders is gained through the access panels located just below the windshield on both sides of the fuselage. (See figure 3-46.) Each master cylinder consists of a cylinder body, a sliding control valve, a piston and springs. A toggle linkage operates the sliding control valve and serves to anchor the cylinder body to the fuselage structure. The piston rod end is attached to the rudder pedal linkage. With the rudder pedals released (brakes off), the spring-loaded control valve is positioned to block off the pressure port of the cylinder and to open the return port to the brake system return line. In the brakes off position, the piston

in the cylinder is retracted and the lower brake line is opened to the brake system return line by a poppet valve in the piston. This prevents pressure build-up due to thermal expansion and permits the hydraulic fluid to flow from the emergency reservoir to keep the lower brake lines filled. When the rudder pedals are depressed (brakes applied), force is transmitted to the piston rod which closes the poppet valve and then moves the cylinder body to actuate the toggle linkage. This positions the sliding control valve to admit utility pressure and to close off the return port. When pressure builds up in the lower brake lines, pressure in the boost chamber acts against the sliding control valve and moves it to an intermediate position closing off the return and pressure ports. If no utility system hydraulic pressure is presented to the brake system, the master brake cylinders, when actuated, manually supply an effective braking pressure to the brake assemblies (approximately one-third effectiveness).

### 3-232. REMOVING WHEEL BRAKE SYSTEM POWER MASTER CYLINDER.

- a. Exhaust hydraulic pressure.
- b. Gain access to master brake cylinders by removing the access panel directly below the windshield on the right- or left-hand side of the fuselage.
- c. Disconnect three hydraulic lines from master brake cylinder and cap openings.
- d. Remove nut, washers and bolt attaching rod end of cylinder to bell crank.
- e. Support master brake cylinder and remove cotter pin, nut, washer and bolt attaching trunnion end (toggle linkage) of master brake cylinder to fitting support.
- f. Remove master brake cylinder from airplane.

### 3-233. INSTALLING WHEEL BRAKE SYSTEM POWER MASTER CYLINDER.

- a. Prior to installing, adjust master brake cylinder at rod end to obtain 12 27/32 inches between attaching points when cylinder is fully retracted.

#### Note

Upon installation, readjust master cylinder length, if necessary, to fit between attaching points when fully retracted. If brake system control linkage is properly adjusted, the master cylinder will need very little readjusting.

- b. Position trunnion end (toggle linkage) of master cylinder to fit on support fitting and secure with bolt, washers, nut and cotter pin.
- c. Install rod end of master cylinder on bell crank and secure with bolt, washers and nut.
- d. Remove caps and connect three hydraulic lines to master cylinder.
- e. Bleed wheel brake system. (Refer to paragraph 3-226.)
- f. Check wheel brake system. (Refer to paragraph 3-224.)
- g. Install access panel.

### 3-234. WHEEL BRAKE SYSTEM RETURN BUNGEE.

3-235. The rudder pedal return bungees are located adjacent to the power master brake cylinder in the same bay. The bungees aid in returning the rudder pedals and master cylinders to the brakes off position when the rudder pedals are released. During a normal brake application, the return bungee moves overcenter aiding, rather than opposing, the pedal travel. Therefore, the bungee does not resist maximum force to the master brake cylinders.

### 3-236. REMOVING WHEEL BRAKE SYSTEM RETURN BUNGEE.

- a. Gain access to return bungee by removing the access panel directly below the windshield on the right- or left-hand side of the fuselage.
- b. Remove nut, washer and bolt attaching rod end of bungee to bell crank.
- c. Remove cotter pin, nut, washer and bolt attaching trunnion end of bungee to support fitting.
- d. Remove bungee from airplane.

### 3-237. INSTALLING WHEEL BRAKE SYSTEM RETURN BUNGEE.

- a. Position trunnion end of bungee to fit on support fitting and secure with bolt, washers, nut and cotter pin.
- b. Adjust rod end of bungee so that it can be installed on bell crank without depressing spring and without end play; then, lengthen rod end one and one-half turns and secure with locknut.
- c. Install rod end of bungee on bell crank and secure with bolt, washers and nut.
- d. Check wheel brake system. (Refer to paragraph 3-224.)
- e. Install access panel.

### 3-238. WHEEL BRAKE SYSTEM EMERGENCY RESERVOIRS.

3-239. The wheel brake system emergency reservoirs are installed in the brake system return lines to retain hydraulic fluid for replenishing the lower brake lines and to supply the hydraulic fluid necessary to manually operate the brakes in the event no hydraulic power is present. The emergency reservoirs are filled by successive applications of the brakes during normal operation. The reservoirs are located on the pressure bulkhead in the radar bay.

### 3-240. WHEEL BRAKE SYSTEM RETURN LINE FILTER.

3-241. Refer to paragraph 3-49.

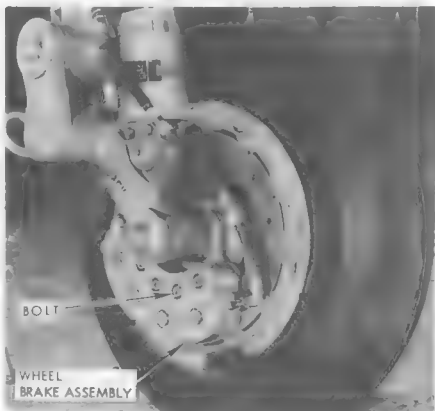
3-242. REMOVING AND INSTALLING WHEEL BRAKE SYSTEM RETURN LINE FILTER. Refer to paragraph 3-51.

3-243. REMOVING, CLEANING AND REPLACING WHEEL BRAKE SYSTEM RETURN LINE FILTER ELEMENT. Refer to paragraph 3-52.

## 3-244. WHEEL BRAKE ASSEMBLY.

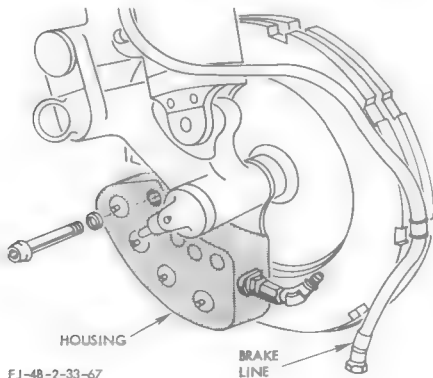
3-245. A wheel brake assembly is mounted on each main landing gear axle flange to produce effective braking action at the wheels. Each unit consists of a housing, four pistons with automatic adjusting mechanisms, a center carriage, a backplate, two steel rotating disks and 16 composition linings. The rotating disks are keyed to the main landing gear wheel. When hydraulic pressure is introduced to the brake assemblies, the pistons are forced out to compress the rotating disks and brake linings together. The friction developed between the rotating disks and linings results in an effective braking action at the wheels. When pressure is released, a return spring inside the piston returns the piston to a brakes off position. The automatic adjusting mechanism maintains a constant running clearance as the brake lining wears. It ensures that regardless of the amount of wear, the same travel of the piston will be required to compress the rotating disks and lining.

## 3-246. REMOVING AND DISASSEMBLING WHEEL BRAKE ASSEMBLY.

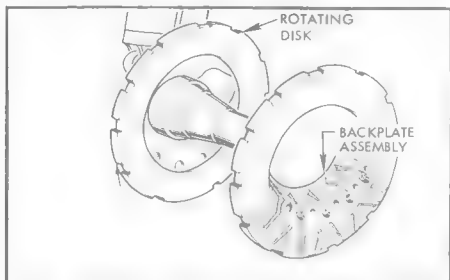


**Note** When strut jack is to be used, prior to jacking, remove bolt shown. Use of strut jack will hinder removal of bolt.

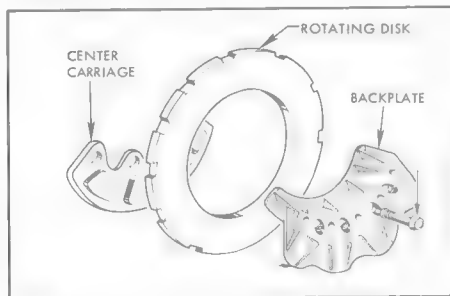
- 1** Place airplane on jacks. (Refer to paragraph 1-14.)
- 2** Remove wheel. (Refer to paragraph 3-157.)
- 3** Disconnect and cap hydraulic brake line.
- 4** Support brake assembly; break safety wire and remove five bolts and washers from housing side of brake assembly.



- 5** Remove brake housing, rotating disk and backplate assembly from axle torque flange.



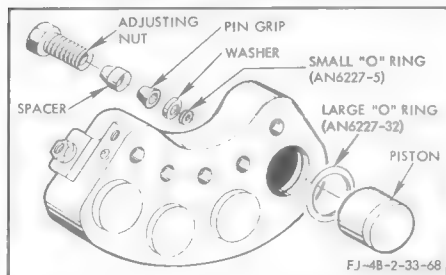
- 6** Break safety wire and remove four bolts and washers attaching center carriage to backplate. Remove rotating disk.



- 7** Break safety wire; remove adjusting nuts, spacers, pin grips and washers from brake housing.

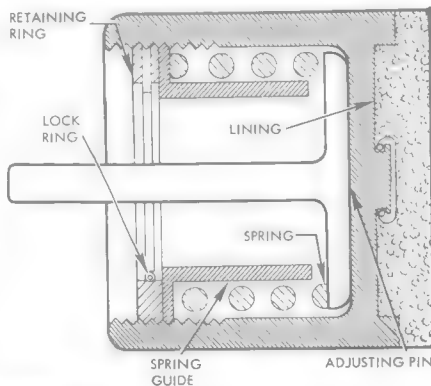
- 8** Use a soft object to force pistons from brake housing.

- 9** Remove small "O" rings (AN6227-5) and large "O" rings (AN6227-32) from cylinder housing.



- 10** Remove linings from pistons, center carriage and backplate.

**Note** Keep all linings in the original sequence.



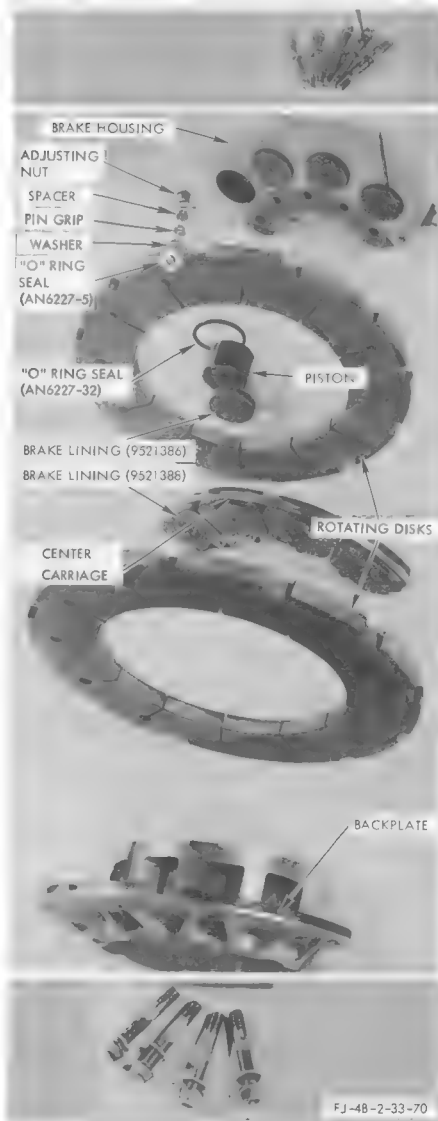
- 11** Although seldom necessary, the pistons may be disassembled as follows:

- Remove lock ring.
- Place piston in an arbor press with adjusting pin pointing upward.
- Apply down pressure to the spring guide and remove threaded retaining ring.
- Release arbor press slowly and remove spring guide, spring and adjusting pin.

**Note** Clean all metal parts with Stoddard Solvent (item 119, materials list).

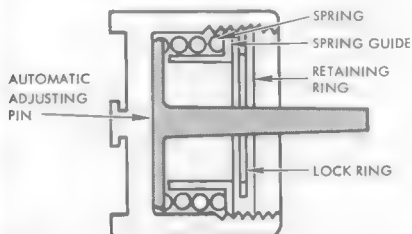
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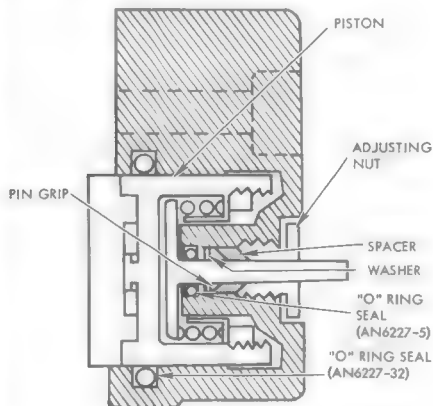
3-247. ASSEMBLING AND INSTALLING WHEEL  
BRAKE ASSEMBLY.

**Note** Prior to assembly inspect all parts for cleanliness and condition. Replace as necessary. Replace all "O" ring seals.

- 1** If pistons were disassembled, assemble as follows:
  - A. Place piston in arbor press with open end pointing upward.
  - B. Install automatic adjusting pin, spring, spring guide and retaining ring into piston.
  - C. Apply pressure to spring guide until it bottoms. Screw threaded retaining ring into piston until it bottoms on spring guide. Back off retaining ring one complete turn and move to nearest locking position. This is to provide the proper built-in clearance.
  - D. Secure retaining ring with lock ring and remove piston from arbor press.



- 2** Lubricate piston, cylinder walls and "O" ring groove sparingly with a light coat of grease (item 82, materials list).
- 3** Install "O" rings in groove provided in cylinder housing.
- 4** Install piston in brake housing until completely bottomed.
- 5** Place adjusting pin washer, pin grip and spacer in piston housing and partially install adjusting nut. Do not tighten nut.



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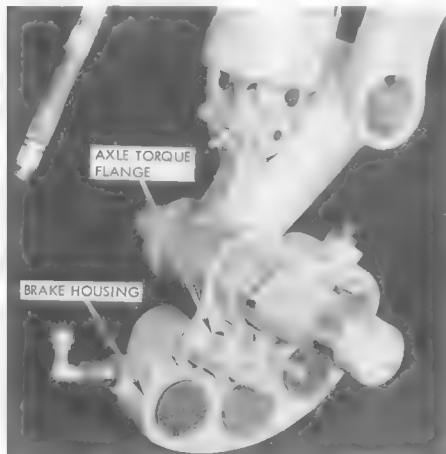
**Section III**  
**Wheel Brake System**

NAVAER 01-60JKE-502

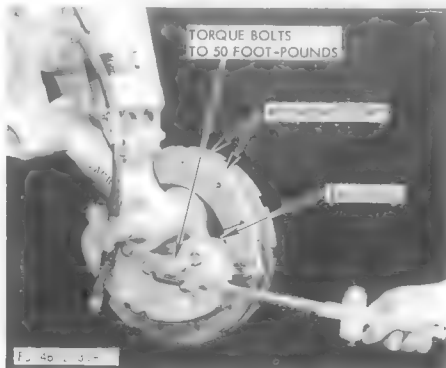
**6** Fill fastener sockets in brake linings with grease (item 83, materials list) and install linings (9521386 and 9521388) on pistons, center carriage and backplate.

**7** Place brake housing onto axle torque flange and hold in place with bolts and washers.

**Caution** Make sure that washers are installed with the countersunk face against the bolthead. Lubricate bolt threads with anti-seize compound (item 131, materials list).



**8** Place rotating disks on backplate and position them to fit on axle torque flange. Secure backplate and brake housing to axle torque flange with five bolts and washers. Tighten bolts evenly and torque to 50 foot-pounds. Safety bolts with lockwire (AN995F41).



**9** Force pistons into brake housing until bottomed and torque adjusting nuts to 20 foot-pounds. Safety nuts in pairs with lockwire (AN995F41).

**Note** Loosen and retorque adjusting nuts several times to ensure proper mating of parts.

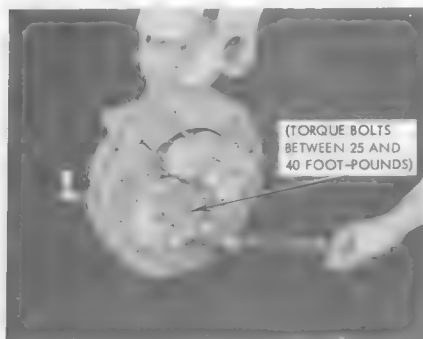


**10** Separate disks and position center carriage to fit on backplate.



- 11** Secure center carriage to backplate with four bolts and washers. Tighten bolts evenly and torque between 25 and 40 foot-pounds. Safety bolts with lockwire (AN995F41).

**Caution** Make sure that washers are installed with the countersunk face against the bolthead. Lubricate bolt threads with anti-seize compound (item 131, materials list).



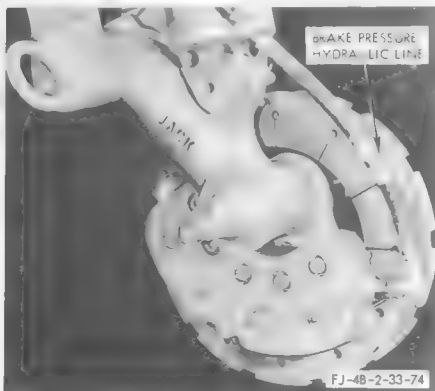
- 12** Remove caps and connect hydraulic line to brake assembly.

- 13** Install wheel. (Refer to paragraph 3-160.)

- 14** Bleed brake. (Refer to paragraph 3-226.)

- 15** Check wheel brake system. (Refer to paragraph 3-224.)

- 16** Remove jack from strut.



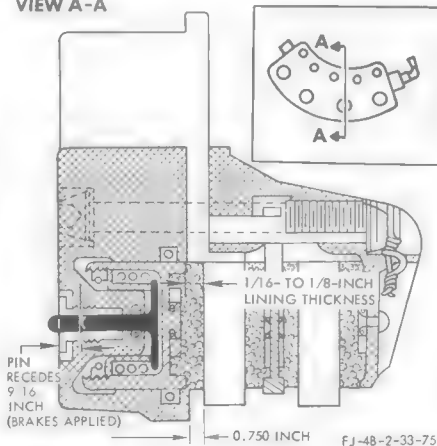
### 3-248. CHECKING AND RESETTNG WHEEL BRAKE ASSEMBLY.



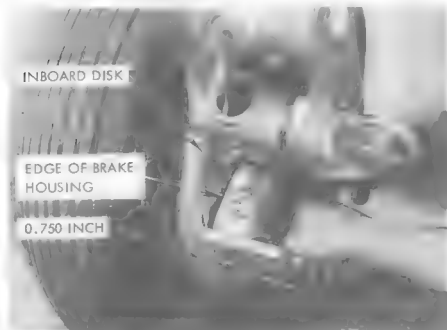
#### CHECKING

When the distance between the inside edge of the brake housing and the outside edge of the outboard rotating disk becomes 0.750 of an inch with the brakes applied, inspect lining for wear. If any brake lining above the brake lining cavity is less than 1/16- to 1/8-inch thick, all brake linings must be replaced. Alternate method is to apply the brakes and check the distance the automatic adjusting pins recede into the adjusting nuts. When this distance becomes 9/16 of an inch, the linings must be replaced.

#### VIEW A-A



**Note** If one lining warrants replacement, all linings must be replaced.



RESETTING

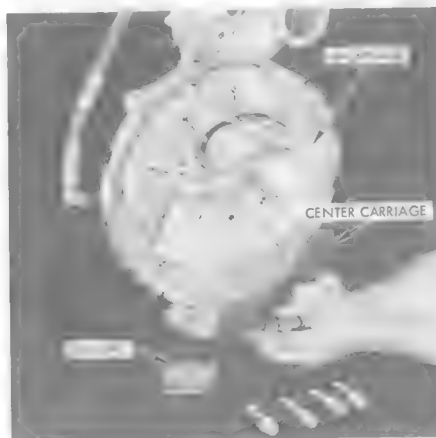
- 1** Jack main landing gear strut. (Refer to paragraph 1-14.)
- 2** Remove wheel. (Refer to paragraph 3-157.)
- 3** Break safety wire and remove four bolts and washers securing center carriage to backplate.
- 4** Remove center carriage from backplate.
- 5** Remove the old brake linings from the pistons, center carriage and backplate by inserting a screwdriver under the linings and prying up.
- 6** Install new linings on pistons, center carriage and backplate.

**Note** Fill fastener sockets of linings with grease (item 83, materials list) before installing.

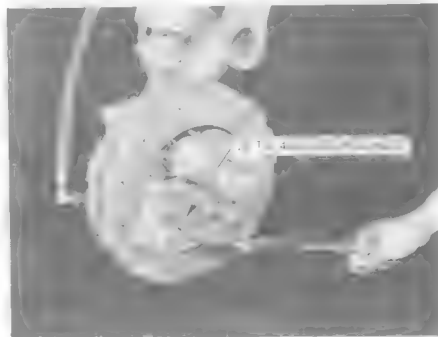
- 7** To reset automatic adjusting pins, break safety wire on adjusting nuts and loosen.
- 8** Force pistons into brake housing as far as possible.
- 9** Torque adjusting pin nuts evenly to 20 foot-pounds and safety in pairs with lockwire (AN995F41).



- 10** Position center carriage to fit on backplate and secure with four bolts and washers.

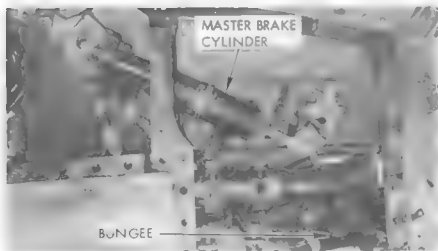
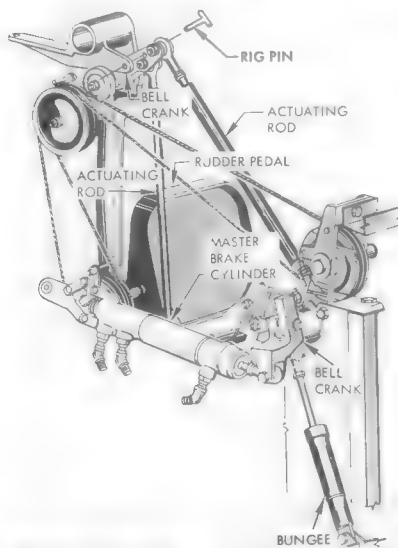


- 11** Torque bolts from 25 to 40 foot-pounds and safety with lockwire (AN995F41).



**Caution** Make sure the washers are installed with the countersunk face against the bolthead. Lubricate the bolt threads with anti-seize compound (item 131, materials list).

- 12** Install wheel. (Refer to paragraph 3-160.)
- 13** Remove jack from strut. (Refer to paragraph 1-14.)
- 14** Check wheel brake system. (Refer to paragraph 3-224.)

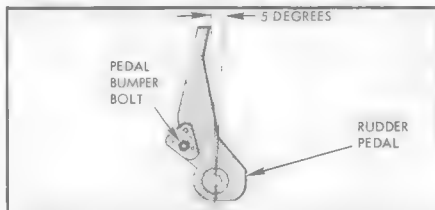
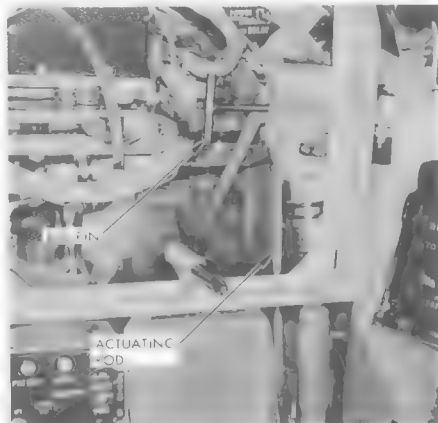
3-249. RIGGING AND ADJUSTING WHEEL  
BRAKE SYSTEM CONTROL LINKAGE.

**1** Position rudder pedals in neutral position.

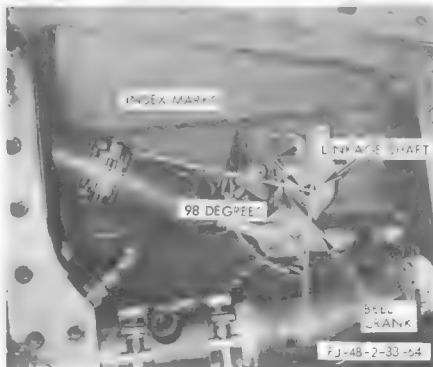
**2** Insert 5/16-inch rig pin through bell crank and support.



**3** With the bumper bolt installed in the lower forward hole of the rudder pedal, adjust rod between pedal and bell crank to position rudder pedal 5 degrees forward from vertical position.



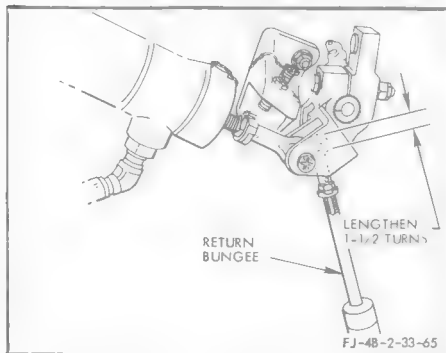
**4** Check that index marks on brake control linkage shaft and master cylinder actuating bell crank align to provide angle shown.



- 5** Adjust brake master cylinder's retracted length at rod end to obtain 12-27/32 inches between centers of attaching points. Attach trunion end (toggle linkage) of cylinder to structural support. Readjust rod end, if necessary, to obtain 0.850-inch dimension between horizontal centerlines of rod end attach point and control linkage shaft.



- 6** Adjust length of return bungee so that it can be installed without depressing the spring and without end play. Lengthen bungee at rod end 1-1/2 turns and install.

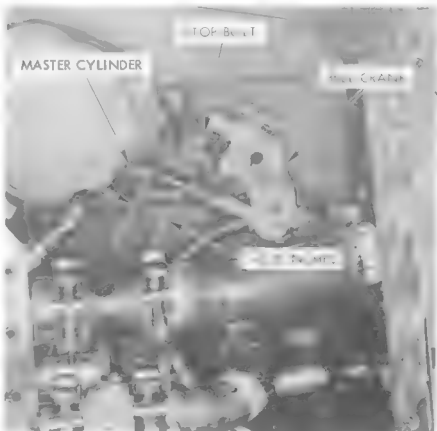


- 7** Adjust rod shown to fit between the two bell cranks and install.



- 8** Remove rig pin.

- 9** With no hydraulic pressure in the brake master cylinder, depress rudder pedal to extend master cylinder 1-5/8 inches (approximately 25 degrees pedal travel) and adjust stop bolt to bottom on master cylinder actuating bell crank.



- 10** Bleed wheel brake system. (Refer to paragraph 3-226.)

- 11** Check wheel brake system. (Refer to paragraph 3-224.)

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**SPEED BRAKE SYSTEM****3-250. SPEED BRAKE SYSTEM.**

3-251. Speed brakes have been incorporated to assist the pilot in slowing down the airplane under all flight conditions. Four speed brake panels have been utilized; two are attached on each side of the aft fuselage midway between the empennage and the field break and two are installed on the bottom of the fuselage, aft of the arresting hook.

**3-252. FUNCTION OF SPEED BRAKE SYSTEM—PANELS OPENING.**

3-253. When the selector switch on the power control lever is moved to "OUT," primary bus power is directed to the open solenoid of the selector valve. Utility hydraulic system pressure is ported through the open line to the lock and dump valve. The lock valve allows free flow and directs pressure to the open side of both forward speed brake actuating cylinders. Initial movement of each cylinder unlocks the speed brake panels, and the extending pistons open the panels. Linkage, connected to the left-hand forward speed brake hinge beam, positions the servo valve to "AFT SPEED BRAKES OPEN." Hydraulic pressure, ported through the servo valve, unlocks and opens the aft speed brakes. Return flow during opening operation is routed to the reservoir through the close ports of the selector and servo valves.

**3-254. FUNCTION OF SPEED BRAKE SYSTEM—PANELS CLOSING.**

3-255. When the selector switch on the power control lever is moved to "IN," primary bus power is directed to the close solenoid of the selector valve. Utility hydraulic system pressure is ported to the close side of the forward speed brake actuating cylinders and the lock and dump valve. Pressure to the lock and dump valve unseats the dump spool which permits passage of return fluid

through the open line. After the forward speed brakes have closed, final movement of the actuating cylinder locks the panels. Initial movement of the left-hand forward speed brake panel repositions the servo valve to "CLOSE." Hydraulic pressure, ported through the servo valve, closes and locks the aft speed brakes. As the aft speed brake panels approach 10 degrees from the fully closed position, they engage the panel closing bungees. Any malfunction which prevents pressure being applied to the unlock port of the lock and dump valve, when the panels are open, results in a hydraulic lock in the open line. The speed brakes can then be closed only by actuation of the dump mechanism.

**3-256. FUNCTION OF SPEED BRAKE SYSTEM—PANELS OPEN—LANDING GEAR EXTENDED.**

3-257. When the speed brakes are open and landing gear "DOWN" is selected, the aft speed brakes automatically close. Primary bus power is directed, through the landing gear switch down relay, to the aft speed brake retract valve. Hydraulic pressure is then ported to the hydraulic ram in the servo valve. The hydraulic ram overrides the mechanical linkage bungee and repositions the servo valve to "AFT SPEED BRAKES CLOSED." The aft speed brakes close and lock while the forward speed brakes remain open. When landing gear "UP" is selected, the forward and aft speed brakes will assume the same position. Direct mechanical linkage between the forward and aft speed brakes, through the servo valve lever assembly, acts as a governing medium. This assures that the forward and aft speed brake panels will open and close at approximately the same time and speed when the landing gear handle is in the "UP" position.

**3-258. TROUBLE SHOOTING SPEED BRAKE SYSTEM.****Note**

Aft speed brake operation is dependent to a certain extent upon proper operation of the forward speed brakes.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>FORWARD SPEED BRAKES DO NOT OPERATE.</b>		
Circuit breaker open.		
No hydraulic pressure.	Refer to paragraph 3-7.	
Defective selector switch.		Replace switch.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>FORWARD SPEED BRAKES DO NOT OPERATE. (Cont)</b>		
Defective selector valve.	<p>Install hydraulic pressure gages in the open and the close lines from the selector valve.</p> <ol style="list-style-type: none"> <li>Remove plug from selector valve.</li> <li>Move switch to "IN" and check for 28 volts dc at pin "B" of valve connector plug.</li> <li>Move switch to "OUT" and check for 28 volts dc at pin "A" of valve connector plug.</li> <li>Check continuity from pin "C" of valve connector plug to ground.</li> <li>If preceding checks are found satisfactory, the external circuit is satisfactory.</li> <li>Check for continuity between pin "A" and pin "C" and between pin "B" and pin "C" of receptacle on valve. If continuity is not complete, replace valve.</li> <li>Valve may be sticking or leaking internally.</li> </ol>	Replace valve. (Refer to paragraph 3-273.)
Defective lock and dump valve.	<ol style="list-style-type: none"> <li>Remove return line from return port of speed brake lock and dump valve. Cap line.</li> <li>Operate speed brake switch with power on.</li> <li>Check for loss of fluid at return port of lock and dump valve. There should be no flow.</li> </ol>	Replace lock and dump valve. (Refer to paragraph 3-266.)
Lock and dump valve not rigged correctly.	Unlock and push in PUSH TO DUMP knob. Manually attempt to close speed brake panels. Panels should close.	Rerig lock and dump valve. (Refer to paragraph 3-267.)
Speed brake dump knob not in normal position.		Reset speed brake dump knob.
<b>AFT SPEED BRAKES DO NOT OPERATE.</b>		
Servo valve linkage not rigged properly.		Rerig linkage. (Refer to paragraph 3-276.)
Defective servo valve.		Replace servo valve. (Refer to paragraph 3-276.)
Defective retract valve.		Replace retract valve. (Refer to paragraph 3-279.)
<b>HYDRAULIC PRESSURE LOW WHEN SPEED BRAKE SWITCH IS OPEN.</b>		
Lock and dump valve partially open.	Check position of PUSH TO DUMP knob. If knob is out and locked, check rigging.	Rerig lock and dump valve. (Refer to paragraph 3-267.) Rerig dump mechanism on servo valve. (Refer to paragraph 3-268.)

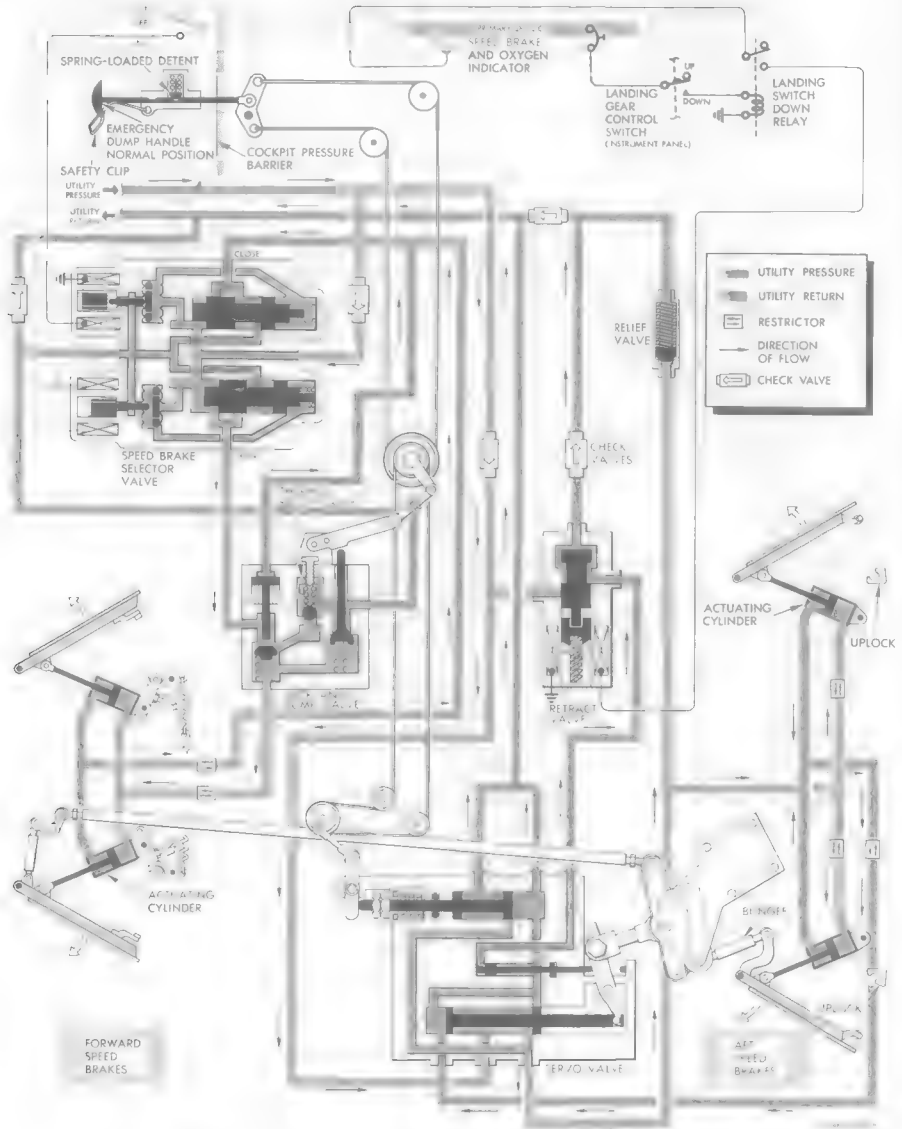


Figure No. 3-49. Speed Brake System Schematic—Panels Opening

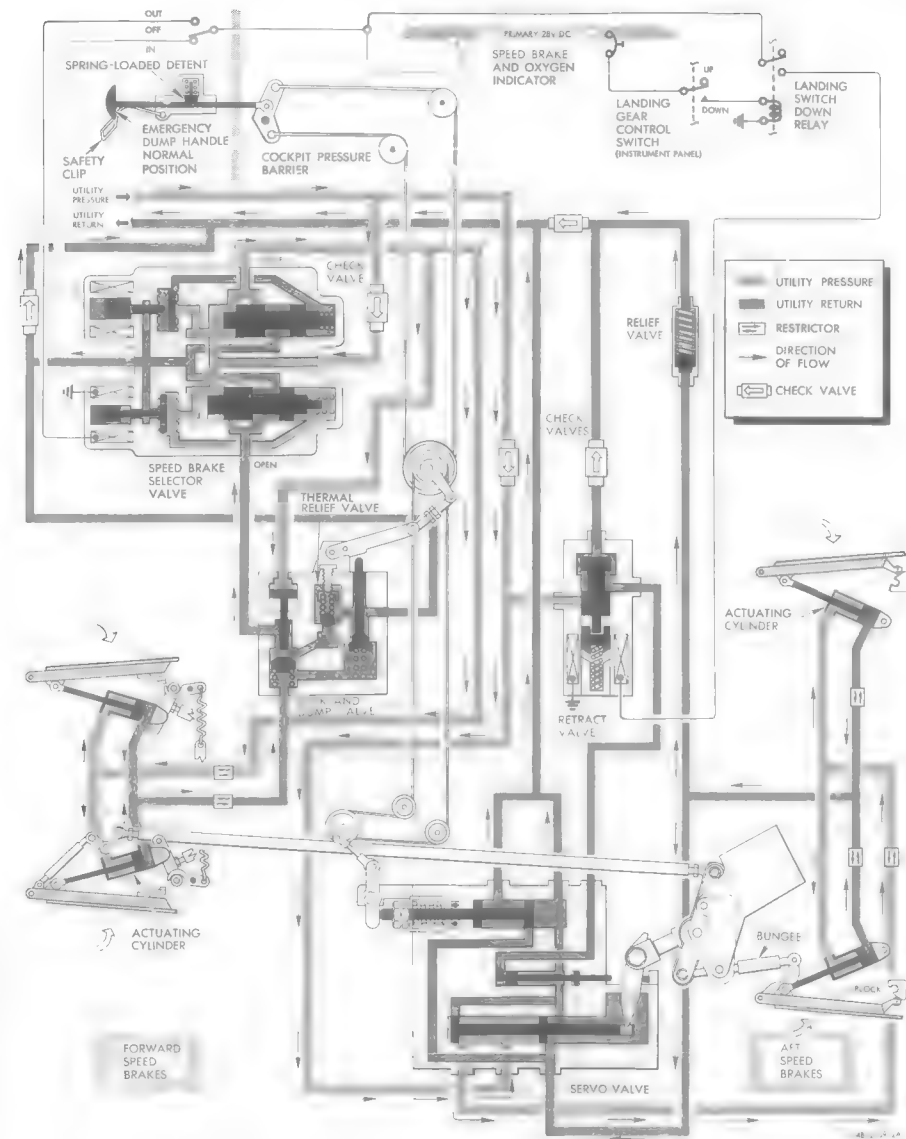


Figure No. 3-50. Speed Brake System Schematic—Panels Closing

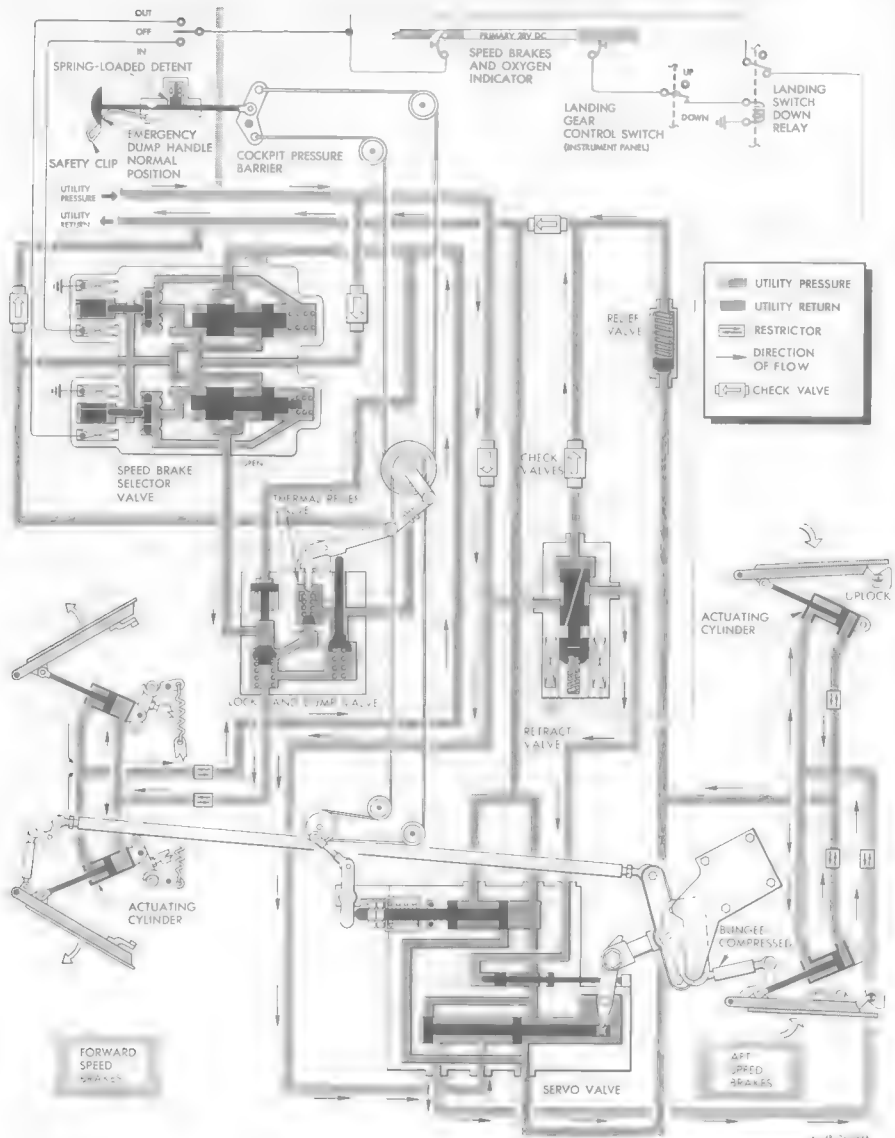


Figure No. 3-51. Speed Brake System Schematic—Panels Open—Landing Gear Extended

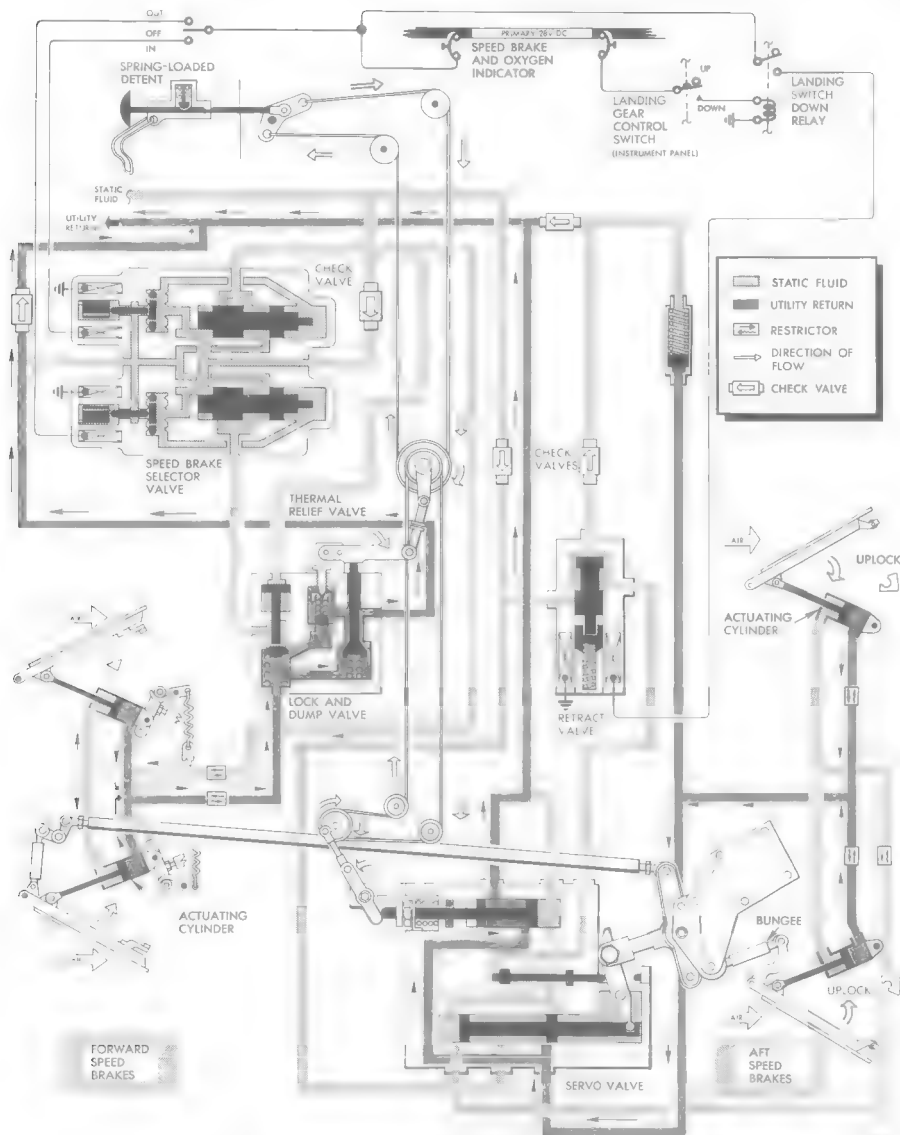


Figure No. 3-52. Speed Brake System Schematic—Dump Mechanism Actuated



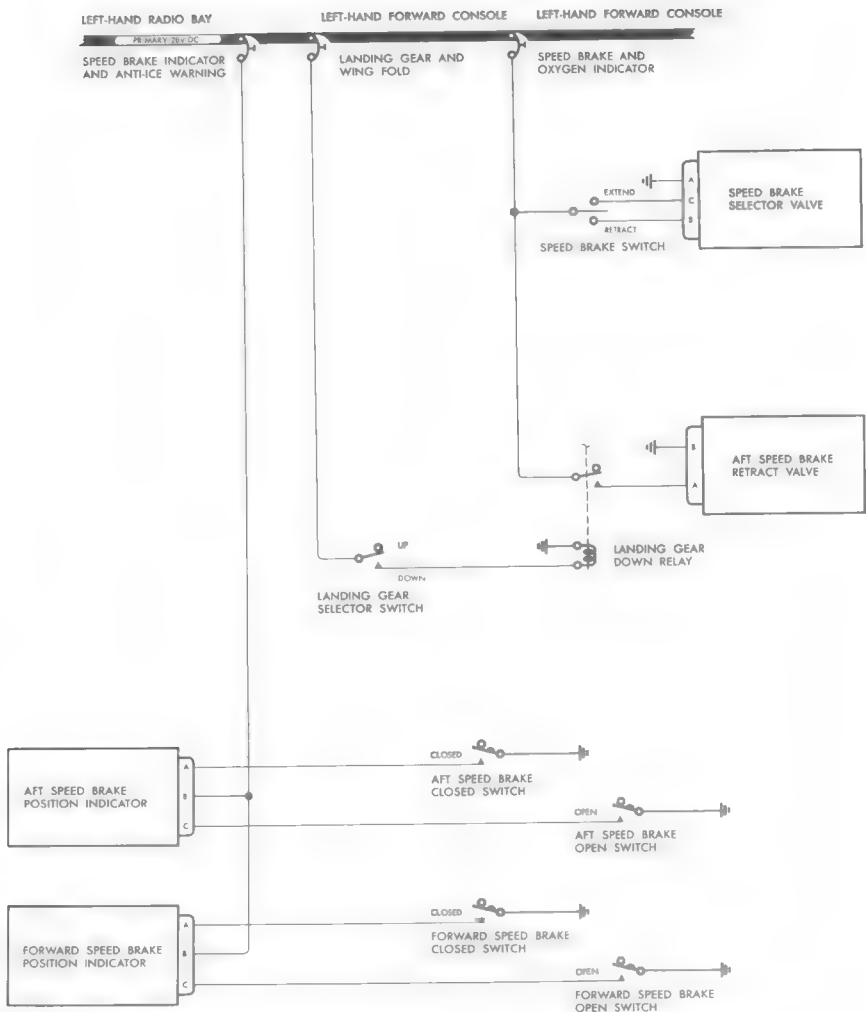


Figure No. 3-53. Speed Brake Electrical System Schematic

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
<b>FORWARD SPEED BRAKES FAIL TO CLOSE WHEN PUSH TO DUMP KNOB IS PUSHED IN.</b>		
Lock and dump valve not rigged correctly.		Rerig lock and dump valve. (Refer to paragraph 3-267.)
Defective lock and dump valve.		Replace valve. (Refer to paragraph 3-266.)
<b>AFT SPEED BRAKES FAIL TO CLOSE COMPLETELY WHEN PUSH TO DUMP KNOB IS PUSHED IN.</b>		
Dump mechanism on servo valve not rigged correctly.		Rerig dump mechanism. (Refer to paragraph 3-268.)
<b>SPEED BRAKES DO NOT OPEN TOGETHER IN FLIGHT.</b>		
Speed brake door latches not adjusted correctly.		Readjust door latches. (Refer to paragraphs 3-286 and 3-287.)
<b>SPEED BRAKES BLOW CLOSED IN FLIGHT.</b>		
Defective lock and dump valve.	<ul style="list-style-type: none"> <li>a. Using hydraulic pressure, open speed brakes.</li> <li>b. Move selector switch to neutral.</li> <li>c. Attempt to manually close the forward speed brakes. Panels should not tend to close.</li> </ul>	Replace valve. (Refer to paragraph 3-266.)

### 3-259. CHECKING SPEED BRAKE SYSTEM.

3-260. Use the following procedure for checking the speed brake system:

a. Connect test stand to utility hydraulic system; adjust stand for 13 gpm at 3000 psi.

b. Connect 28-volt d-c external electrical power source.

c. Place airplane on jacks.

d. Select landing gear "UP." Operate speed brakes several times. The speed brakes should unlock and open together in 2.5 to 4 seconds.

e. Install a hand pump and pressure gage in the forward speed brakes open line and remove small access doors from brake panels. Check that door latches unlock when hydraulic pressure is between 800 and 1000 psi; pressure differential between latches should not exceed 50 psi. To check aft speed brake panel locks, refer to paragraph 3-287.

f. Check speed brake position indicators for proper operation. Indicators should show "IN" with speed brakes fully closed and "OUT" when forward and aft speed brake panels are full open. When there is no electrical power available or the panels are at an intermediate position, a barber pole indication should be visible.

g. With speed brakes open, place selector switch to "NEUTRAL"; then, unlock and push in PUSH TO DUMP knob. Manual pressure applied to speed brakes should cause panels to close. Return PUSH TO DUMP knob to "RESET" position and lock after completing check.

h. Select landing gear "DOWN." Aft speed brakes should not open when selector switch is positioned to "OUT."

i. Select landing gear "UP." Open speed brakes. Select landing gear "DOWN"; aft speed brakes should close and lock.

j. Check all hydraulic units, connections and lines for freedom from leaks and structural interference.

### WARNING

Aft speed brakes will close rapidly and forcibly from 10 to 0 degrees. Keep personnel and equipment clear.



Figure No. 3-54. Speed Brake Dump Control

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>SPEED BRAKES CLOSED; NO "IN" INDICATION ON FORWARD SPEED BRAKE INDICATOR. (Cont)</b>			
Electrical malfunction of indicating circuit or components. (Cont)	Check test point CSL to ground.	28 volts dc.	Replace defective wire segment to indicator.
		Zero volts.	Replace defective circuit breaker.
<b>SPEED BRAKES OPEN; NO "OUT" INDICATION ON AFT SPEED BRAKE INDICATOR.</b>			
Indicator switch not properly rigged.	Check switch rigging.		Rig switch. (Refer to paragraph 3-292.)
Electrical malfunction of indicating circuit or components.	Check test point CSN to ground.	Zero ohms.	Continue trouble shooting procedure.
		Other than zero ohms.	Perform wire segment continuity check and replace defective switch or wire.
	Check test point CSP to ground.	28 volts dc.	Replace defective indicator.
		Zero volts.	Continue trouble shooting procedure.
	Check test point CSL to ground.	28 volts dc.	Replace defective wire segment to indicator.
		Zero volts.	Replace defective circuit breaker.
<b>SPEED BRAKES CLOSED; NO "IN" INDICATION ON AFT SPEED BRAKE INDICATOR.</b>			
Indicator switch not properly rigged.	Check switch rigging.		Rig switch. (Refer to paragraph 3-292.)
Electrical malfunction of indicating circuit or components.	Check test point CSQ to ground.	Zero ohms.	Continue trouble shooting procedure.
		Other than zero ohms.	Perform wire segment continuity check and replace defective switch or wire.
	Check test point CSP to ground.	28 volts dc.	Replace defective indicator.
		Zero volts.	Continue trouble shooting procedure.
	Check test point CSL to ground.	28 volts dc.	Replace defective wire segment to indicator.
		Zero volts.	Replace defective circuit breaker.
<b>POWER FAILURE.</b>			
Defective circuit breaker.	Check test point PDN to ground.	28 volts dc.	Replace circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.
	Check test point PGS to ground.	28 volts dc.	Replace circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>SPEED BRAKES FAIL TO CLOSE WHEN DUMP KNOB IS ACTUATED.</b>			
Dump mechanism not properly rigged.	Unlock and push in dump knob. Manually attempt to close speed brakes. Panels should close.		Rig lock and dump and servo valves. (Refer to paragraphs 3-267 and 3-268.)
<b>SPEED BRAKES DO NOT OPEN TOGETHER IN FLIGHT.</b>			
Panel latches incorrectly adjusted.	Check speed brake system. (Refer to paragraph 3-259.)		Adjust panel latches. (Refer to paragraphs 3-286 and 3-287.)
<b>SPEED BRAKES BLOW CLOSED IN FLIGHT.</b>			
Defective lock and dump valve.	a. Using hydraulic pressure, open speed brakes. b. Move control switch to neutral. c. Attempt to manually close the forward speed brakes. Panels should not tend to close.		Replace lock and dump valve. (Refer to paragraph 3-266.)

### 3-259. CHECKING SPEED BRAKE SYSTEM.

3-260. Use the following procedure for checking the speed brake system:

a. Connect test stand to utility hydraulic system; adjust stand for 13 gpm at 3000 psi.

b. Connect 28-volt d-c external electrical power source.

c. Place airplane on jacks.

d. Select landing gear "UP." Operate speed brakes several times. The speed brakes should unlock and open together in 2.5 to 4 seconds.

e. Install a hand pump and pressure gage in the forward speed brakes open line and remove small access doors from brake panels. Check that door latches unlock when hydraulic pressure is between 800 and 1000 psi; pressure differential between latches should not exceed 50 psi. To check aft speed brake panel locks, refer to paragraph 3-287.

f. Check speed brake position indicators for proper operation. Indicators should show "IN" with speed brakes fully closed and "OUT" when forward and aft speed brake panels are full open. When there is no electrical power available or the panels are at an intermediate position, a barber pole indication should be visible.

g. With speed brakes open, place selector switch to "NEUTRAL"; then, unlock and push in PUSH TO DUMP knob. Manual pressure applied to speed brakes should cause panels to close. Return PUSH TO DUMP knob to "RESET" position and lock after completing check.

h. Select landing gear "DOWN." Aft speed brakes should not open when selector switch is positioned to "OUT."

i. Select landing gear "UP." Open speed brakes. Select landing gear "DOWN"; aft speed brakes should close and lock.

j. Check all hydraulic units, connections and lines for freedom from leaks and structural interference.

### WARNING

Aft speed brakes will close rapidly and forcibly from 10 to 0 degrees. Keep personnel and equipment clear.



Figure No. 3-54. Speed Brake Dump Control

Revised 1 November 1957

## 3-261. RELIEVING HYDRAULIC PRESSURE.

## RELIEVING HYDRAULIC PRESSURE

To relieve hydraulic pressure in the speed brake lines when the fuselage is parted at the field break:

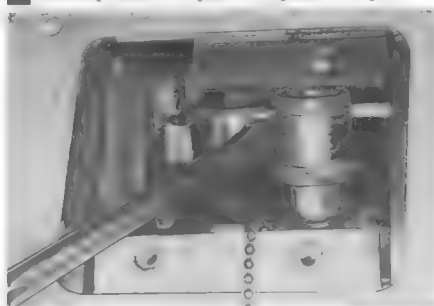
- 1 Loosen "B" nut of the utility hydraulic system return.



- 2 Actuate the lock and dump valve by means of cables.



- 3 Manually unlock the speed brake panels and open.



- 4 After work is completed, tighten "B" nut and service utility hydraulic system. (Refer to paragraph 3-8.)

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## 3-262. SPEED BRAKE LOCK AND DUMP MECHANISM.

3-263. The forward speed brake lock and dump valve is a combination check and thermal relief valve. It incorporates provisions to manually close the speed brakes under emergency conditions. A floating piston in the valve creates a hydraulic lock in the open line to prevent the panels from closing when the selector valve is de-energized. The thermal relief provisions prevent excessive pressures from damaging the speed brake actuating system. A dump mechanism for the aft speed brakes is included in the servo valve.

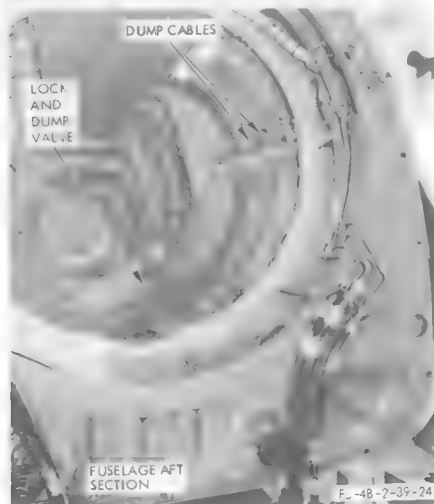
## 3-264. LOCK AND DUMP MECHANISM LINKAGE.

3-265. The emergency closing linkage consists of a knob and bell crank, a pair of cables routed to the aft fuselage, two sectors, two levers and two push-pull rods. One push-pull rod is connected to a lever on the lock and dump valve; the other rod is connected to the dump mechanism on the servo valve. A spring safety clip secures the cockpit PUSH TO DUMP knob in the "NORMAL" position. When the clip is released and the knob is pushed aft, the linkage actuates the valves to the "DUMPED" position. The linkage may be reset by pulling the knob forward and locking it. A spring-loaded ball on the handle support serves to maintain the knob in either position.

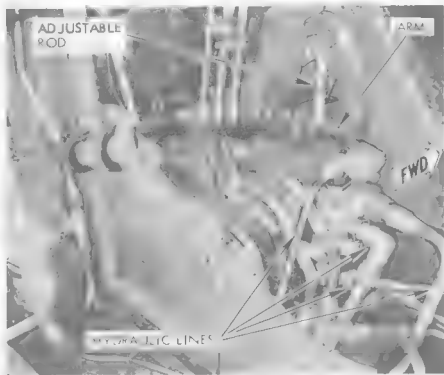
## 3-266. REMOVING AND INSTALLING LOCK AND DUMP VALVE.

## REMOVING

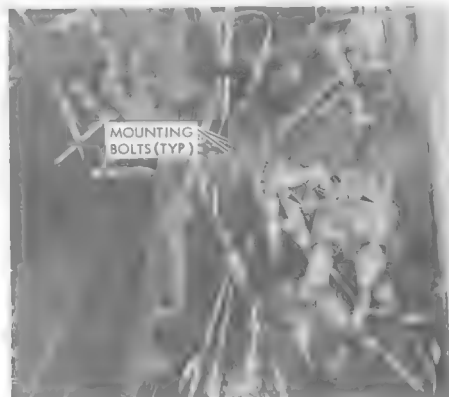
- 1 Remove fuselage aft section. (Refer to paragraph 2-6.)



- 2** Disconnect adjustable rod from lock and dump valve.



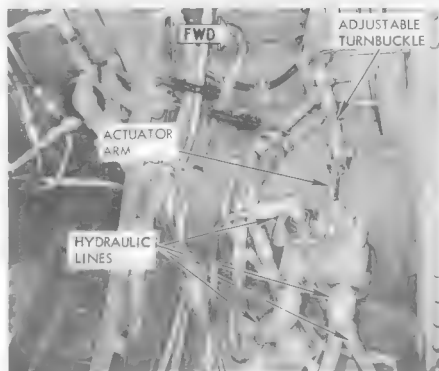
- 3** Disconnect hydraulic lines and remove mounting bolts.



## INSTALLING

- 1** Position lock and dump valve on mounting bracket and install bolts.
- 2** Connect hydraulic lines.
- 3** Connect adjustable rod to lock and dump valve.

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- 4** To rig lock and dump valve, refer to paragraph 3-267.  
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## 3-267. RIGGING LOCK AND DUMP VALVE.

*Note* To rig lock and dump valve, remove engine tail pipe and attach fuselage aft section.

- 1** Insert rig pins in following places:

- A Bell crank aft of pressure barrier



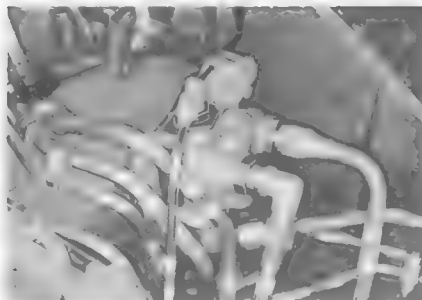
- B. Sector above lock and dump valve



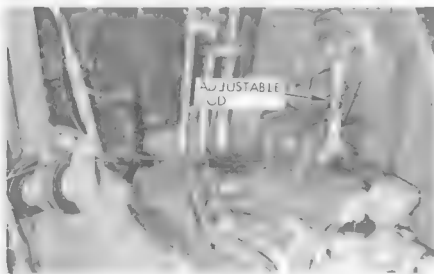
FJ-48-2-39-26



### C. Lock and dump valve lever

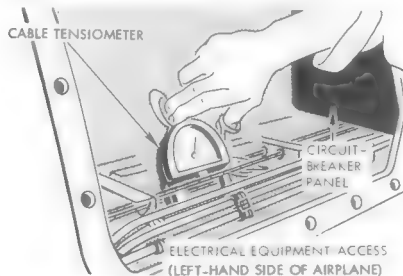


- 2 Adjust rod to fit and remove rig pins.



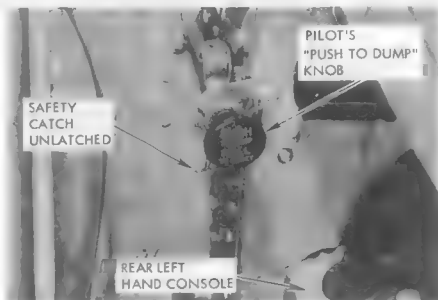
- 3 Connect disconnects.

- 4 Adjust turnbuckles to 40 (±4) inch-pounds tension on cables at 21.1°C (70°F).



- 5 Remove all rig pins and check emergency closing of speed brakes by pushing in on PUSH TO DUMP knob. Manual pressure applied to the speed brake panels should cause them to close; they will not lock.

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- 6 Lockwire turnbuckles and disconnects.
- 3-268. RIGGING AFT SPEED BRAKE DUMP MECHANISM.

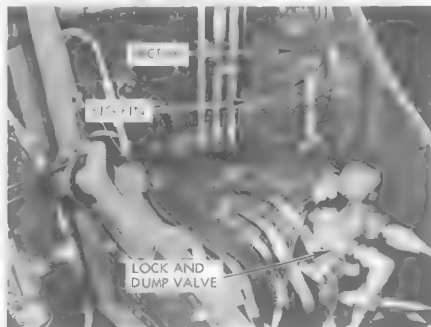
### RIGGING

- 1 Ascertain that forward speed brake lock and dump valve is correctly rigged prior to rigging servo valve dump mechanism. (Refer to paragraph 3-267.)

- 2 Remove aft fuselage section. (Refer to paragraph 2-6.)

- 3 Install rig pins in following places:

#### A. Sector above lock and dump valve.



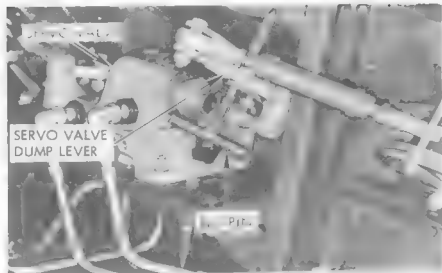
#### B. Sector forward of servo valve.



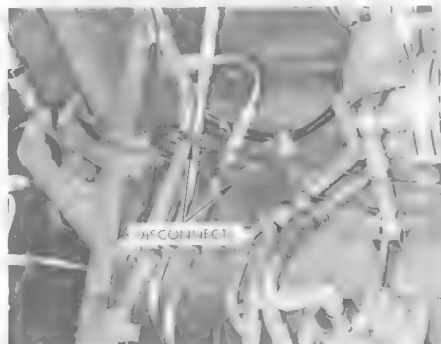
## Section III Speed Brake System

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### C. Servo valve dump lever.



- 4** Adjust disconnects until cables have an equal tension of 40 (± 4) pounds.



- 5** Install adjustable rod between sector and servo valve dump lever.



- 6** Remove all rig pins and check position of both sectors and servo valve dump lever. With the PUSH TO DUMP knob in the reset position, servo valve dump button must not be depressed.

- 7** Tighten all check nuts and safety-wire all disconnects.

- 8** Install aft fuselage and check emergency closing of speed brakes. After unlocking and pushing in PUSH TO DUMP knob, manual pressure applied to the speed brake panels should cause them to close.

**Caution** Door closing bungees shut the aft speed brake panels very rapidly from the 10 degrees open position to fully closed. Keep all tools and personnel clear.

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### 3-269. FUNCTION OF SPEED BRAKE DUMP MECHANISM.

3-270. When the PUSH TO DUMP knob in the cockpit is unlocked and pushed in, the dump side of the forward speed brake lock and dump valve ports the speed brake open lines, between the lock valve and the actuating cylinders, to return. The forward speed brake panels will be pushed to a trail position by air loads. A continuation of the same linkage is connected to the dump mechanism in the servo valve. The spool in the servo valve, upon being repositioned by actuation of the dump feature, ports the open side of the aft speed brake actuating cylinders to utility hydraulic system return. The panels are then trailed by air loads to within 10 degrees of closed; at this point, the door closing bungees are engaged. The bungees rapidly shut the aft speed brake panels to the fully closed position. The lock and dump valve is mounted on the lower left-hand side of the aft fuselage. The servo valve is located inboard of the left-hand forward speed brake panel.

### 3-271. SPEED BRAKE SELECTOR VALVE.

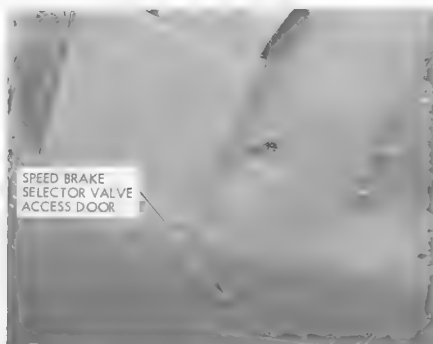
3-272. The speed brake selector valve consists of two sliding spool and solenoid assemblies incorporated in a machined housing. Each spool and solenoid assembly operates independently. When the selector valve is energized for operation of the system, hydraulic pressure is ported through the valve to the actuating cylinders. Return fluid flows into the return port of the de-energized section of the selector valve and is ported to the utility hydraulic system reservoir. The selector valve is accessible through a door in the bottom of the aft fuselage.

### 3-273. REMOVING AND INSTALLING SPEED BRAKE SELECTOR VALVE.

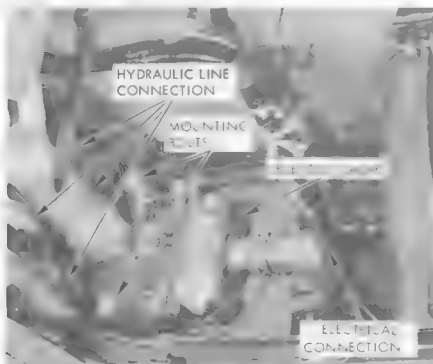
#### REMOVING

- 1** Open access door under fuselage aft section.

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- 2** Remove four hydraulic lines.



- 3** Disconnect electrical leads.

- 4** Remove mounting bolts and withdraw selector valve.

#### INSTALLING

Reverse above procedure for installation.

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#### 3-274. AFT SPEED BRAKE SERVO VALVE.

3-275. The aft speed brake servo valve is a mechanically operated selector valve. It incorporates a dump mechanism and provisions for overriding the linkage which positions the servo valve spool in relation to the forward speed brake panels. The dump mechanism consists of a spool contained in the servo valve body and a lever. A hydraulic ram, incorporated in the servo valve, is actuated through the aft speed brake retract valve. When the retract valve is positioned to extend the hydraulic ram, the bungee in the servo valve actuating linkage is compressed; this repositions the servo valve spool and the aft speed brakes will close and lock.

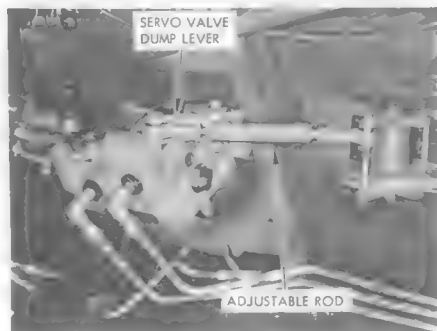
#### 3-276. REMOVING, INSTALLING AND RIGGING AFT SPEED BRAKE SERVO VALVE.

##### REMOVING

- 1** Remove fuselage aft section. (Refer to paragraph 2-6.)
- 2** Relieve hydraulic pressure on speed brakes. (Refer to paragraph 3-261.)
- 3** Disconnect rod between servo valve actuating lever and idler assembly.



- 4** Disconnect rod to servo valve dump lever.

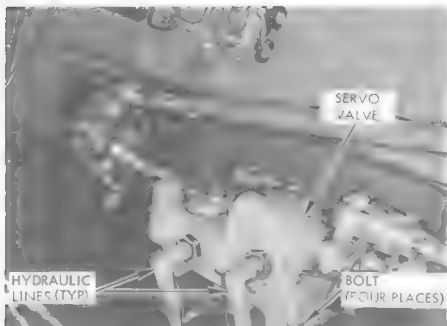


- 5** Disconnect hydraulic lines.
- 6** Remove hold-down bolts and withdraw valve.

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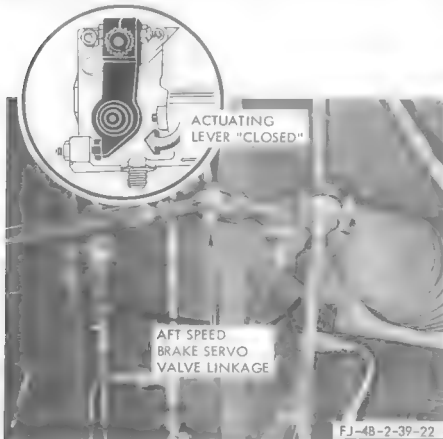
## INSTALLING AND RIGGING

**1** Install servo valve and connect hydraulic lines.

**2** Disconnect servo valve linkage from forward speed brake panel; then ascertain that actuating lever is positioned to speed brakes "CLOSED."

- A. Install aft fuselage section with engine tail pipe removed.
- B. Attach 28-volt d-c external electrical power.
- C. Connect test stand to utility hydraulic system and set for 5.7 gpm at 3000 psi.
- D. Check out forward speed brake panels for proper operation. (Refer to paragraph 3-286.)

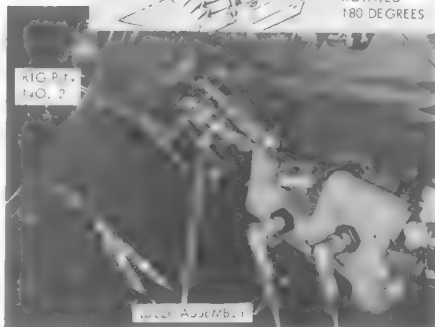
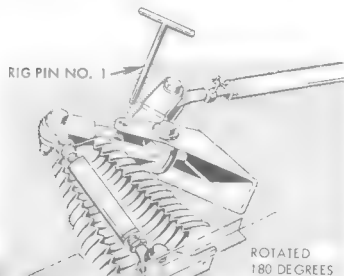
**3** Prior to rigging servo valve, place forward speed brakes in closed and locked position and de-energize utility hydraulic system.



**4** Install linkage which was disconnected in step 2.

**5** Install rig pins in:

- A. Actuating rod bell crank.
- B. Idler assembly.



**6** Install adjustable rod between idler assembly and servo valve actuating lever to provide  $5/32$  ( $\pm 1/32$ ) inch clearance between the actuating lever and the stop bolt on the valve body. Tighten check nut and lockwire.



**7** Remove rig pins. Manually unlock and extend left-hand forward speed brake panel to full open position; then close. Repeat this procedure several times, checking for clearance of all moving parts.

**8** Support airplane on jacks to permit operation of speed brake panels and landing gear.

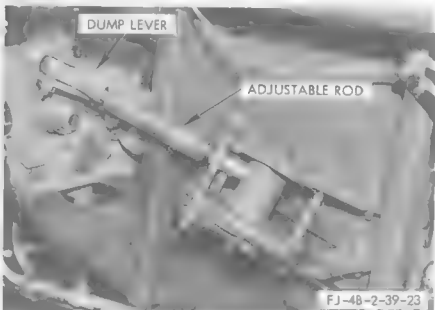
**9** Place landing gear control handle to "UP" position; this de-energizes the aft speed brake retract valve and allows both sets of panels to operate.

**Note** The following circuit breakers should be pushed in: LG & WING FOLD; SPEED BRAKES & OXYGEN INDICATOR; SPEED BRAKE IND & ANTI-ICE WARNING.

**10** Hydraulically operate the speed brake system by use of the speed brake operating switch on the power control lever. Operate several times, checking to see that there is clearance around all mechanical linkage in all degrees of door open position.



**11** Connect adjustable rod to servo valve dump lever. Check dump mechanism of complete speed brake system.



### 3-277. AFT SPEED BRAKE RETRACT VALVE.

3-278. The aft speed brake retract valve is a normally closed, electrically operated valve. When landing gear "down" is selected, a circuit is completed through the landing gear down relay to the retract valve. The retract valve then opens, porting pressure to the hydraulic ram in the servo valve. The hydraulic ram extends, overcoming bungee pressure in the servo valve operating linkage;

this repositions the servo valve spool to speed brakes "CLOSED." The aft speed brakes then close and lock.

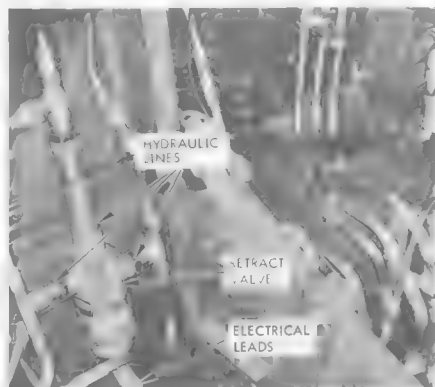
### 3-279. REMOVING AND INSTALLING RETRACT VALVE.

#### REMOVING

**1** Remove aft fuselage section. (Refer to paragraph 2-6.)

**2** Relieve pressure in speed brake lines. (Refer to paragraph 3-261.)

**3** Disconnect hydraulic lines and electrical leads at retract valve.



**4** Remove bolts holding valve to airplane.



#### INSTALLING

Reverse above procedure for installation.

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3-280. SPEED BRAKE ACTUATING CYLINDERS.

3-281. The speed brake actuating cylinders are conventional, sliding-piston assemblies. When the system is in operation, hydraulic fluid enters the open or close port on the cylinder assembly, positioning the speed brake panels accordingly. The forward speed brake actuating cylinders are located in wells on each side of the aft fuselage. The aft speed brake actuating cylinders are located in wells on the bottom of the aft fuselage.

3-282. REMOVING AND INSTALLING FORWARD SPEED BRAKE ACTUATING CYLINDER.

REMOVING

- 1 Open speed brake panels and de-energize utility hydraulic system.
- 2 Disconnect actuating cylinder from speed brake panel.

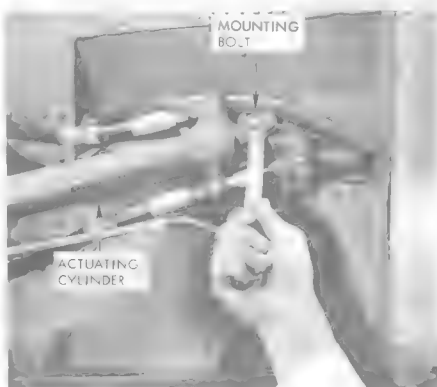


- 3 Disconnect two flexible hydraulic lines from actuating cylinder.



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- 4 Remove actuating cylinder mounting bolt and withdraw cylinder.



INSTALLING

- 1 Place actuating cylinder on mounting bracket and install mounting bolt. (Refer to removal step 4.)
- 2 Connect two hydraulic lines to the actuating cylinder. (Refer to removal step 3.)
- 3 Attach actuating cylinder to speed brake panel.



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3-283. REMOVING AND INSTALLING AFT SPEED  
BRAKE ACTUATING CYLINDER.

## REMOVING

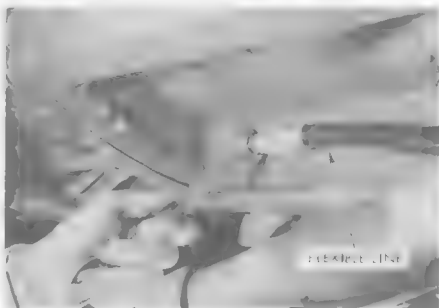
- 1 Open speed brake panels and de-energize utility hydraulic system.



- 2 Disconnect actuating cylinder from panel.



- 3 Disconnect two flexible hydraulic lines from the actuating cylinder.



- 4 Remove mounting bolt and withdraw cylinder.

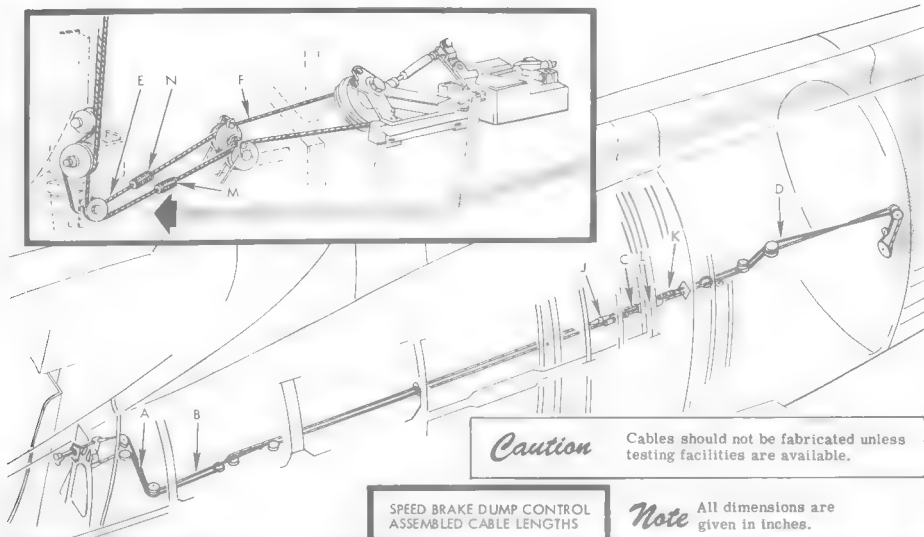


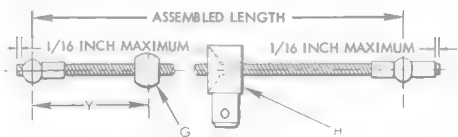
## INSTALLING

Reverse above procedure for installation.

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CODE	PART NUMBER	PART NUMBER	ASSEMBLED LENGTH	DIAMETER	TYPE
A	RA2500-2 AN664-C2	AN669-S2 RH	112-1/8 ( ± 1/8)	1/16	CARBON STEEL 7 x 7
B	RA2500-2 AN664-C2	AN669-S2 LH	120-1/16 ( ± 1/8)	1/16	CARBON STEEL 7 x 7
C	AN663-C2	AN669-S2 LH	9-5/8 ( ± 1/8)	1/16	CARBON STEEL 7 x 7
D*	AN664-C2	AN663-C2	148-11/16 ( ± 1/8)	1/16	CARBON STEEL 7 x 7
E*	AN664-C2	AN664-C2	26-13/16 ( ± 1/8)	1/16	CARBON STEEL 7 x 7
F*	AN664-C2	AN664-C2	33-9/32 ( ± 1/8)	1/16	CARBON STEEL 7 x 7
CODE	PART NUMBER	NAME			
G*	RA2487-2	BALL TERM.			
H*	181-520130	LOCK			
J	AN155-B5	BARREL			
K	1206-001A	DISCONNECT			
L	RA225B- 2	TRULOC DISCONNECT			
M	PA-100-N2 (2) PA-100-C2 (2)	NUT CROSSPIECE			
N	PA-100-S2 (2)	SLEEVE			

"Y" DIMENSION

D	75 ( ± 1/8)
E	13-1/2 ( ± 1/8)
F	18-13/32 ( ± 1/8)

\* Detail Cables D, E and F

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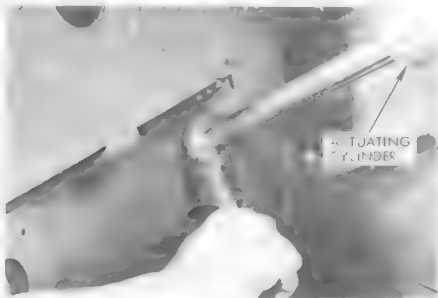
Figure No. 3-55. Fabrication of Speed Brake Dump Control Cables

**3-284. SPEED BRAKE PANELS.**

3-285. The forward speed brake panels are located on each side of the aft fuselage, midway between the empennage and the field break. The aft speed brake panels are on the bottom of the aft fuselage, to the rear of the arresting hook. The panels extend 50 degrees when open and fair with the fuselage when closed; they are electrically controlled by a selector switch on the power control lever.

**3-286. REMOVING, INSTALLING AND ADJUSTING FORWARD SPEED BRAKE PANELS.****REMOVING**

- 1** Open speed brake panels; then remove fuselage aft section. (Refer to paragraph 2-6.)
- 2** Relieve pressure in speed brake lines. (Refer to paragraph 3-261.)
- 3** Disconnect actuating cylinder from speed brake panel.



- 4** Disconnect servo valve actuating bell crank from upper hinge beam of left-hand forward speed brake panel.



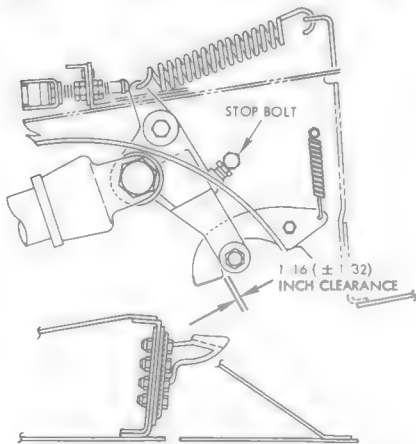
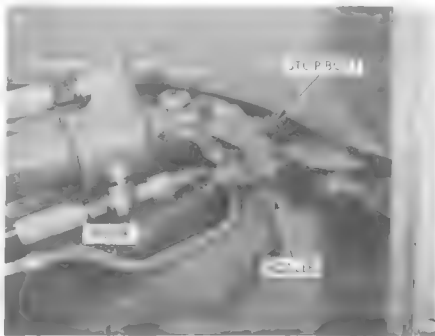
- 5** Remove hinge bolts inside aft fuselage. Support panel to keep it from falling.

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- 6** Disconnect bonding wire from each hinge point.

**INSTALLING**

- 1** Position speed brake panel and install hinge bolts.
- 2** Install bonding wires.
- 3** Attach actuating cylinder to speed brake panel. (See removal step 3.)
- 4** Adjust step bolt to permit roller to nest in hook with  $1/16$  ( $\pm 1/32$ ) inch clearance between roller and hook.



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**Section III**  
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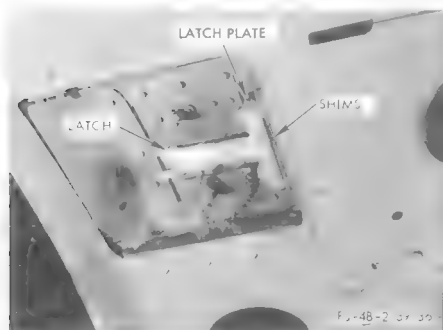
- 5** Adjust latch plate vertically to give 0.045 ( $\pm 0.015$ ) inch gap between latch and hook when speed brake panel is closed.



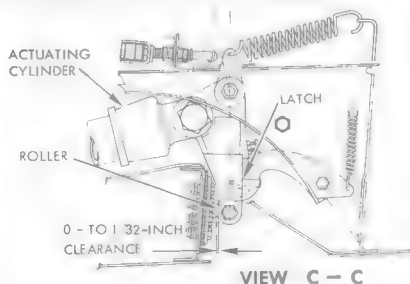
**Note** The latch plate has oversize holes for four-way adjustment.

- 6** Adjust latch fore and aft by adding or removing shims so latch tip passes roller side of hook tip as the speed brake panel closes. Latch tip should then move the roller aft approximately 1/32 inch before the roller moves forward to the locked position.

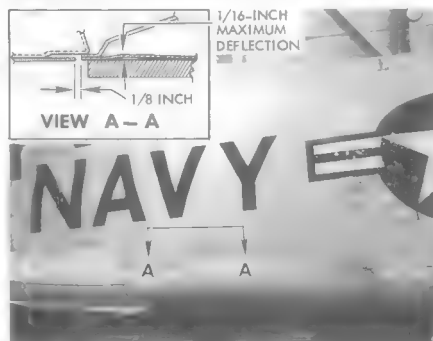
**Note** This condition can be observed through the small access door on the speed brake panel.



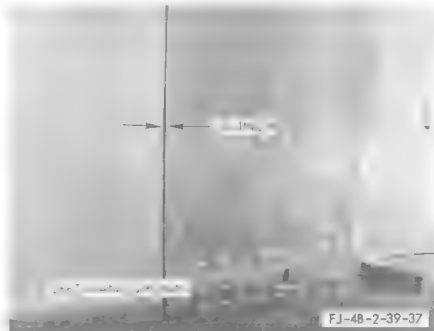
- 7** Adjust length of actuating cylinder so there is 0- to 1/32-inch clearance between the roller and the latch when the speed brake panel is closed and locked.



- 8** Check deflection of speed brake panel in closed position with 3000 psi hydraulic pressure on actuating cylinder. Deflection shall not exceed 1/16 inch.



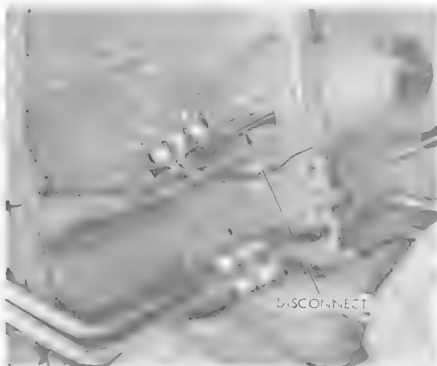
- 9** Check for 1/8-inch gap between speed brake panel and fuselage.



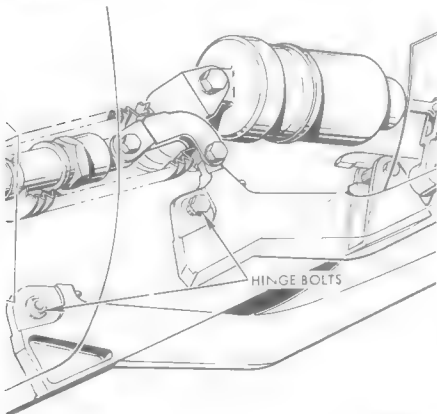
## 3-287. REMOVING, INSTALLING AND ADJUSTING AFT SPEED BRAKE PANELS.

## REMOVING

- 1 Open speed brake panels.
- 2 Remove aft fuselage section. (Refer to paragraph 2-6.)
- 3 Relieve pressure on speed brake hydraulic lines. (Refer to paragraph 3-261.)
- 4 Remove close-out assembly cover and disconnect linkage from aft speed brake hinge (left-hand only).



- 5 Disconnect speed brake panel from actuating cylinder. (Refer to paragraph 3-283.)
- 6 Remove hinge bolts inside of fuselage and pull panel free.



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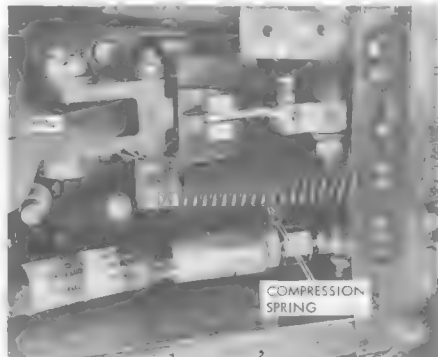
## INSTALLING

*Note* Reverse above procedure for installation.

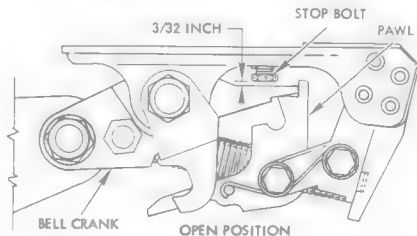
## ADJUSTING

- 1 Attach aft fuselage section with engine tail pipe removed.
- 2 Connect hydraulic test stand to utility hydraulic system. Set stand for 5.7 gpm at 3000 psi. Connect 28-volt d-c external electrical power source and place airplane on jacks.
- 3 Check out forward speed brake panels with aft speed brakes disconnected. (Refer to paragraph 3-286.)
- 4 After completing step 3, close and lock the forward speed brake panels and de-energize the utility hydraulic system.
- 5 To adjust aft speed brake panel locks, proceed as follows:

A. Remove pin and compression spring from door lock assembly.



B. With bell crank and pawl in full open position, adjust stop bolt to 3/32-inch dimension indicated; tighten check nut and lockwire.

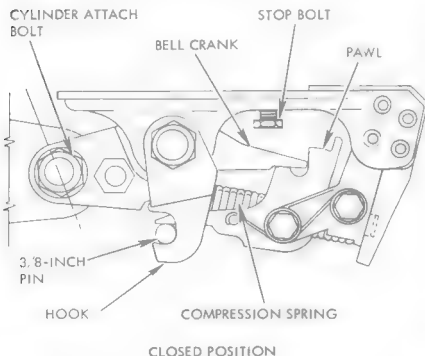


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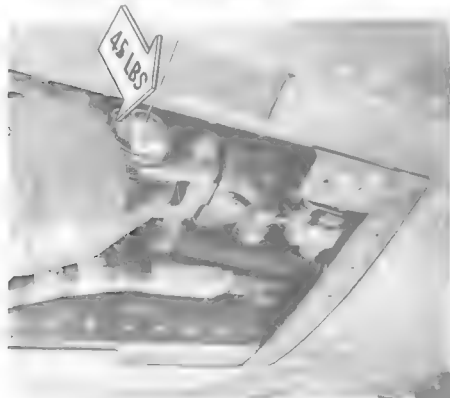
**Section III**  
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- C. Position bell crank and pawl in closed position and reinstall compression spring and pin.
- D. Insert a 3/8-inch diameter pin in hook of bell crank. (The 3/8-inch pin simulates door pin.)



- E. Apply a force of 45 pounds to cylinder attach bolt, perpendicular to bolt and pivot point of bell crank. Bell crank should not actuate.



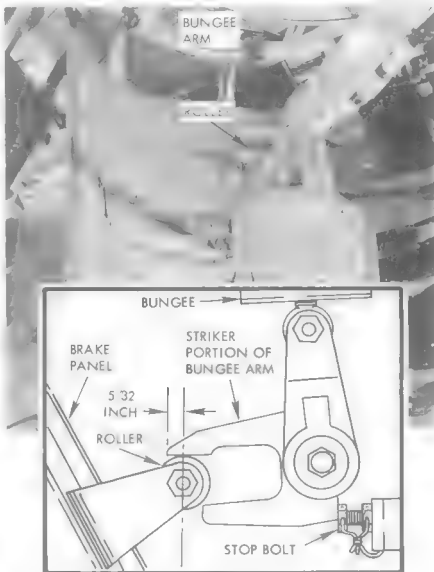
- F. If a force of 45 pounds or less causes bell crank and pawl to actuate, shim forward end of compression spring until condition in step E is met.

6. Hydraulically unlock and open panels, checking proper operation. Aft speed brake panels shall be rigged to unlock with a hydraulic pressure differential not to exceed 50 psi.

7. Manually close aft speed brake panel to approximately 12 degrees from fully closed position.

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8. The roller on the speed brake panel should strike the door closing bungee arm approximately 5/32 inch from the end of the striker portion of the arm. If necessary, adjust roller support by moving or shimming.



9. Manually close left-hand aft speed brake door several times, making sure the roller enters the forked portion of the door closing bungee arm smoothly throughout the entire closing operation.

10. Repeat above procedure for right-hand speed brake panels.

11. Hydraulically operate system from cockpit. Check clearance of all moving parts.

12. When forward speed brake panels are in full open position, check that aft speed brake panels are 50 (± 3) degrees open.

13. With the landing gear handle in "UP" position, hydraulically operate the complete speed brake system. The forward and aft speed brake panels should operate in this check.

14. With the landing gear handle in "DOWN" position, hydraulically operate the speed brake system several times; the aft speed brake panels should remain closed.

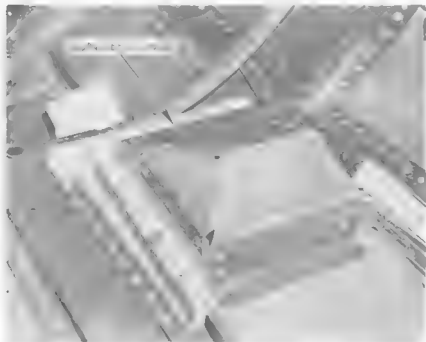
15. Safety all nuts and bolts. Visually check system for hydraulic leaks.

FJ-48-2-39-41

## 3-288. REMOVING, INSTALLING AND ADJUSTING PANEL CLOSING BUNGEEES.

## REMOVING

- 1** Remove aft fuselage section. (Refer to paragraph 2-6.)
- 2** Remove cover over bungee. Disconnect bungee from panel closing arm and airplane structure, then remove.

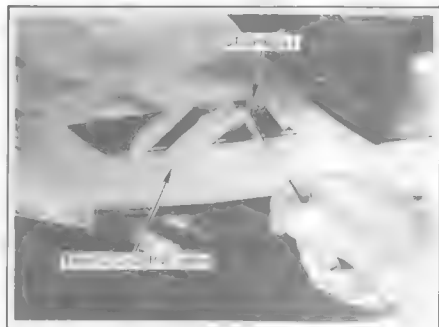
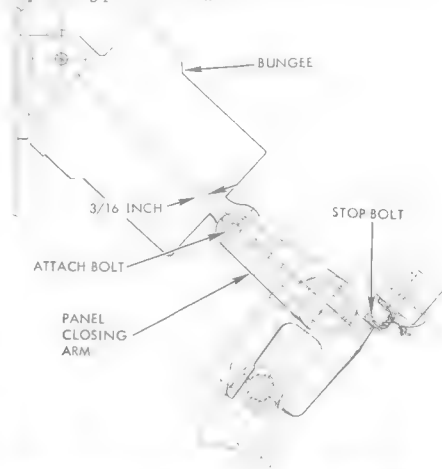


## INSTALLING AND ADJUSTING

- 1** Hydraulically close and lock aft speed brake panels. The roller and panel closing arm shall be engaged.
- 2** Install bungee in the noncompressed condition. Use rod end of bungee for adjustment, if necessary, to meet above condition.

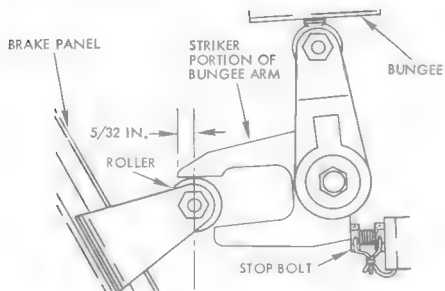


- 3** With the panel closing arm bungee attach bolt 3/16-inch overcenter, adjust stop bolt so it is contacting stop striking portion of arm.



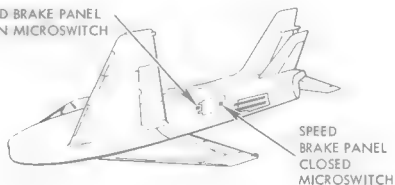
- 4** Safety-wire stop bolt and check nut.
- 5** Hydraulically open aft speed brake panels approximately 15 degrees. Manually close panels, checking proper operation and clearance of panel closing mechanism.
- 6** The roller on the speed brake panel should strike the bungee arm approximately 5/32 inch from the end of the striker portion of the arm. If necessary, adjust roller support by moving or shimming.

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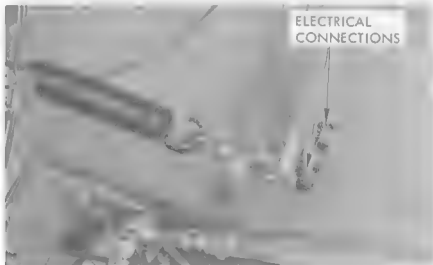
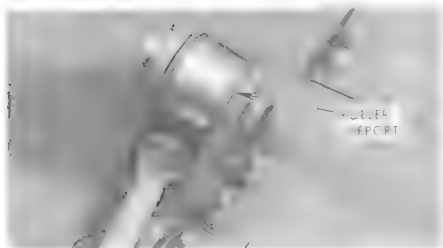
### 3-291. REMOVING, INSTALLING AND ADJUSTING FORWARD SPEED BRAKE INDICATING SWITCHES.

SPEED BRAKE PANEL  
OPEN MICROSWITCH



### REMOVING

- 1 Remove fuselage aft section. (Refer to paragraph 2-6.)
- 2 Relieve hydraulic pressure on speed brake lines. (Refer to paragraph 3-261.)
- 3 Remove the two electrical leads at panel closed switch.



- 7 Safety all nuts and bolts; then install bungee covers.

**Caution** Bungee will close panel rapidly and forcibly. Keep tools and personnel clear.

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### 3-289. SPEED BRAKE INDICATING SYSTEM.

3-290. A speed brake indicating system is incorporated to show the relative position of the speed brake panels. Two instruments (SPEED BRAKES FORWARD and SPEED BRAKES AFT) are located approximately in the center of the instrument panel and each indicates three positions: "IN," "OUT" and "barber pole." The out actuating switch (OUT) for the forward speed brake panels is located above the left-hand upper hinge beam. The in actuating switch (IN) is in the left-hand aft fuselage. The out actuating switch (OUT) for the aft speed brake panels is located in the left-hand close-out assembly. The in actuating switch (IN) for the aft panels is in the left-hand actuating cylinder well. For adjusting switches, refer to paragraphs 3-291 and 3-292.

- 4 Remove retaining nut over plunger housing and pull switch from mounting bracket.





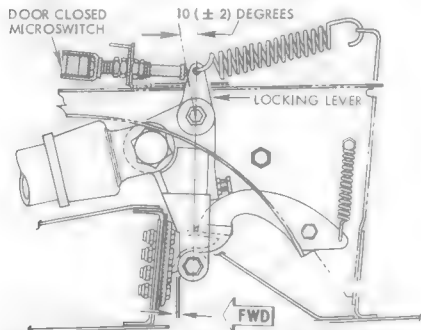
- 5** Remove two electrical leads and two mounting bolts from door open switch before removing.



Reverse above procedure for installation.

### ADJUSTING

- 1** The door closed microswitch is a normally closed switch. As the speed brake panel locks, the in-board end of the locking lever moves aft. This allows the door closed switch to make electrical contact and complete the door closed circuit to the speed brake indicator. Adjust the door closed microswitch to break mechanical contact with the locking lever when the lever is  $10 (\pm 2)$  degrees from fully locked position.



- 2** The door open microswitch is a normally open switch. As speed brake panels open, the lower hinge on the left-hand panel actuates the speed brakes open switch. This completes an electrical circuit to the indicator on the instrument panel. The adjustable actuating bolt on the left-hand lower hinge beam should be set to actuate the door open microswitch when the panel is full open.



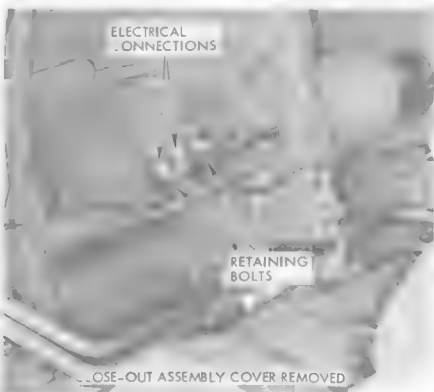
### 3-292. REMOVING, INSTALLING AND ADJUSTING AFT SPEED BRAKE INDICATING SWITCHES.

#### REMOVING

- 1** Open speed brakes and remove aft fuselage section. (Refer to paragraph 2-6.)
- 2** Relieve pressure on speed brake lines. (Refer to paragraph 3-261.)
- 3** Remove electrical connections at panel closed switch.
- 4** Remove retaining bolts and pull switch free.



- 5** Remove close-out assembly cover.
- 6** Remove electrical connections at panel open switch.
- 7** Remove bolts and pull switch free.



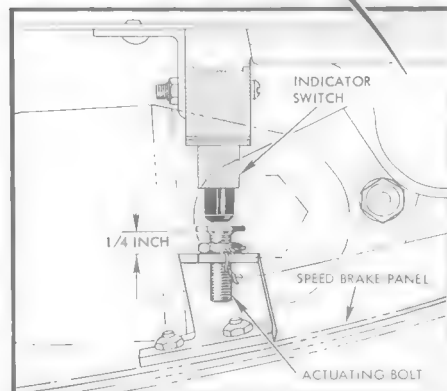
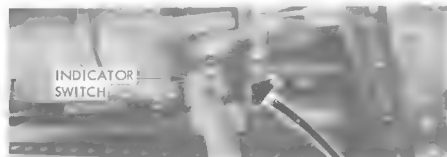
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## INSTALLING

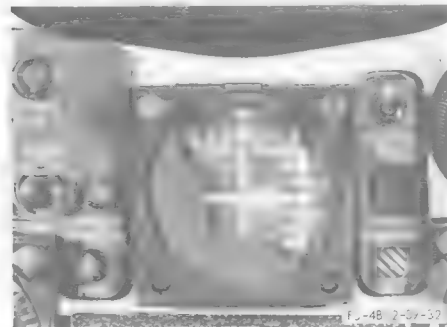
Reverse above procedure for installation.

## ADJUSTING

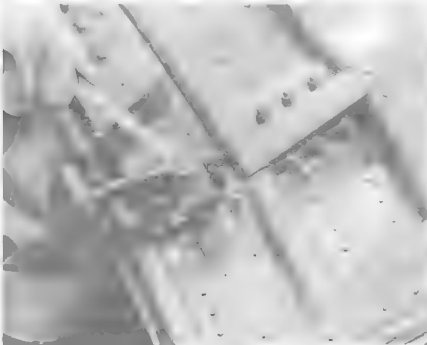
- 1** With left-hand aft speed brake panel open, adjust indicator switch actuating bolt to 1/4-inch minimum dimension as shown.



- 2** Hydraulically close and lock speed brakes, noting indicator on instrument panel. If indicator shows panel locked, open panel and adjust actuating bolt away from switch one-half revolution.

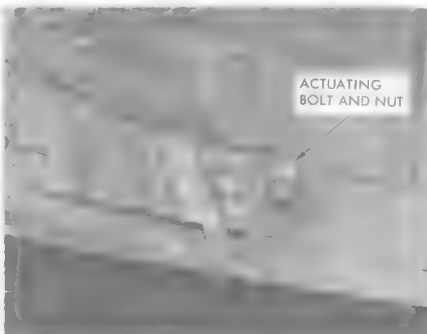


- 3** Repeat step 2 until indicator shows panel unlocked, then adjust actuating bolt one-half revolution toward switch.



- 4** Close and lock panels while noting indicator. If indicator shows unlocked position, repeat step 3 until locked indication is attained.

- 5** Safety-wire actuating bolt and nut.



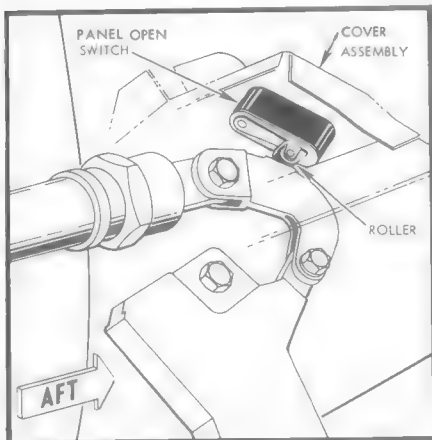
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## PANEL OPEN SWITCH

- 1** Open speed brake panels.
- 2** Remove close-out assembly cover.



- 3** Adjust switch to actuate within last two degrees of panel open travel.



- 4** Close, then open speed brake panels hydraulically. Note indicator in cockpit for proper indication.

FJ-48-2-39-33

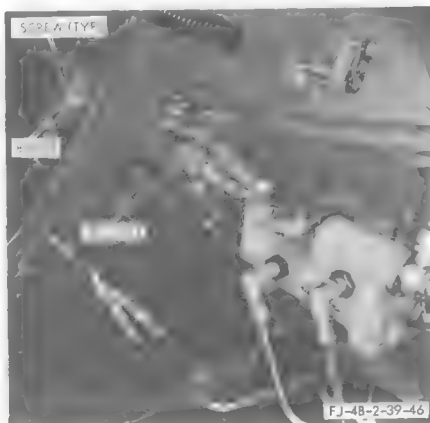
## 3-293. REMOVING, INSTALLING AND RIGGING CONTROL BUNGEE.

## REMOVING

- 1** Remove aft fuselage section with speed brakes closed. (Refer to paragraph 2-6.)
- 2** Remove bolt attaching rod end of bungee to idler mechanism.



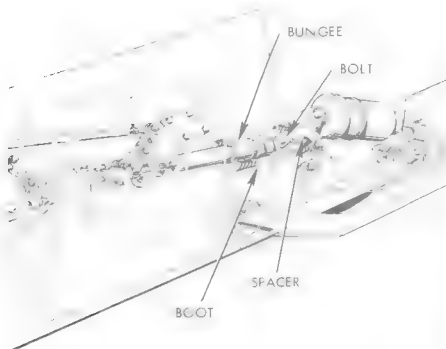
- 3** Remove screws attaching boot to airframe.



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- 4** Remove bolt attaching bungee to spacer. Remove bungee and boot as a unit.



- 3** Adjust rod end of bungee so it may be installed with no initial deflection.



INSTALLING

- 1** Install rig pin in idler mechanism.
- 2** Slip bungee into boot and install in airplane.

- 4** Tighten clamp on forward end of boot to provide an airtight seal. Remove rig pin.

- 5** Mate fuselage sections and perform an operational check on the speed brakes.

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**CATAPULT SYSTEM****3-294. CATAPULT SYSTEM.**

3-295. The catapult system consists of a pivoted catapult hook and a holdback mechanism.

**3-296. CATAPULT HOOK.**

3-297. The catapult hook is attached at the lower centerline of the fuselage, adjacent to the forward section of the wing. It is pivoted so the hook will line up with the pull of the catapult. A bungee is installed to return the hook to its normal position after the catapult pendant is released. A fairing is provided on the fuselage to fair that section of the catapult hook which protrudes below the fuselage mold line.

**3-298. CATAPULT HOOK OPERATION.**

3-299. The catapult pendant is attached to the hook with the hook in the normal position. As the catapult is tensioned, the hook will line up with the load path. When the pendant is released, the hook will return to its faired position.

**3-300. HOLDBACK MECHANISM.**

3-301. The holdback mechanism is attached to the wing center section splice just aft of the main gear wheel well.

A universally pivoted pendant allows for any misalignment of the airplane on the catapult. When the coupon breaks, the holdback unit is retracted by bungee power and is faired into the lower mold line by a door, attached to the pendant. An uplock prevents the unit from extending under high "G" loadings or negative air pressures encountered in certain flight attitudes.

**3-302. HOLDBACK MECHANISM OPERATION.**

3-303. A small trip door is located in the center of the holdback fairing door. Pushing on this trip door will release the uplock hook through a roller and cam arrangement. The holdback door can then be pulled down against the bungee springs. Bottoming of the bungees limits down travel. The coupon is installed and hooked to the holdback cable. When the coupon breaks, the unit is retracted automatically. The uplock is cammed to the unlocked position and then locked by a torsion spring as the holdback unit reaches the full up position. The severed end of the coupon is retained in the pendant until removed by the catapult crew in preparation for the next flight.

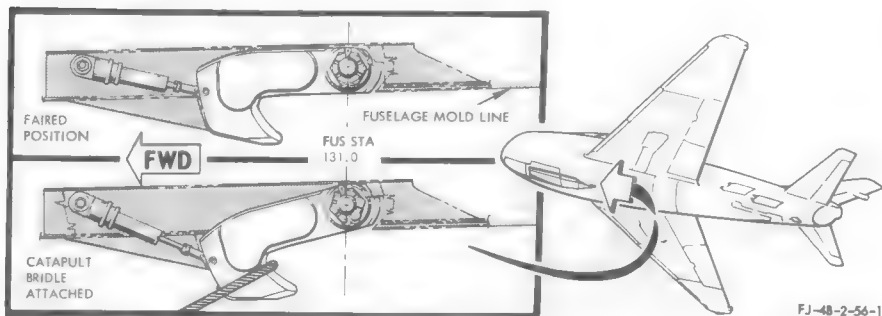
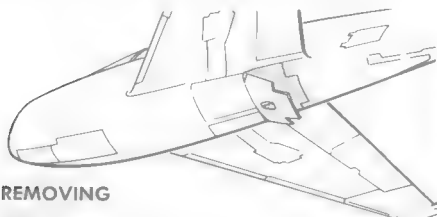


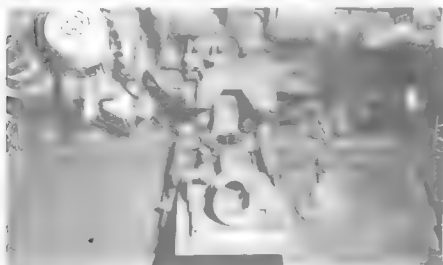
Figure No. 3-56. Catapult Hook Installation

3-304. REMOVING, INSTALLING AND ADJUSTING CATAPULT HOLDBACK MECHANISM.



REMOVING

- 1 Open the engine access door on bottom of fuselage.

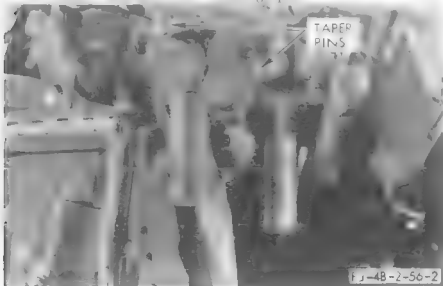


- 2 Disconnect the bonding jumper.

- 3 Wrap left- and right-hand holdback pendant assembly bungee ends together with safety wire to prevent the bungee from springing apart; then remove bungee retaining bolts from engine access door.



- 4 Remove left- and right-hand holdback pendant assembly bungee retaining bracket taper pins by removing the nuts and forcing the pins out. Slide brackets, with bungees attached, off the hinge pin.

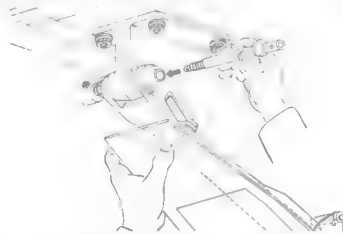


- 5 Remove holdback pendant hinge pin retaining nut and slide hinge pin from mounting bracket. Prevent holdback mechanism from dropping and damaging the fairing door.



INSTALLING

- 1 With the holdback pendant in position, insert the hinge pin through the pendant universal and mounting trunnion from the left-hand side.



- 2 Install the hinge pin retaining nut, washer and cotter pin.

- 3 Install the left- and right-hand holdback pendant bungee retaining bracket. Install the taper pins and nuts.



- 4 Remove the safety wire which was installed around each bungee. Install bungee retaining bolts through engine access door.

- 5 Connect the bonding jumper to the engine access door.

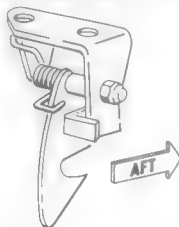
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**REMOVING HOLDBACK UPLOCK MECHANISM**

Remove uplock hook retaining bolt, allowing hook and spring assembly to slide out of mounting bracket.

**INSTALLING HOLDBACK UPLOCK MECHANISM**

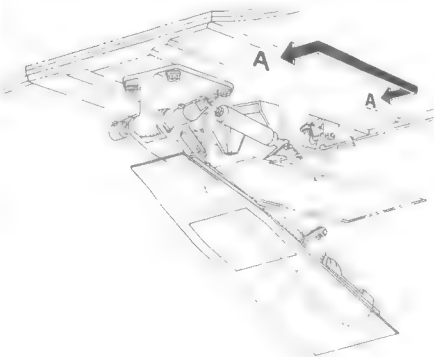
Install hook and spring assembly into bracket with open end of hook pointing aft. Make certain the hook attaching bracket is between the guide arms.

**REMOVING CATAPULT HOLDBACK FAIRING DOOR**

Remove two bolts (one on each side of the aligning mechanism) and remove the fairing door.

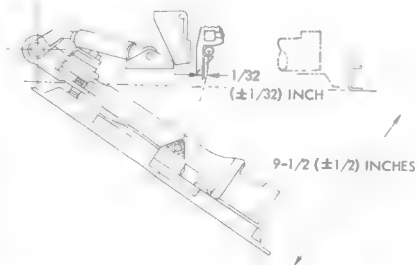
**INSTALLING FAIRING DOOR**

**1** Place fairing door in position and install the upper left- and right-hand attaching bolts. (The bonding jumper is attached to the upper left-hand fairing door mounting bolt.) Use washer shims under the bolts and serrations on the uplock roller to adjust door to the fuselage mold line.



**2** Install one bungee. With the bungee bottomed, adjust the rod end to obtain the 9-1/2 ( $\pm 1/2$ ) inch dimension in view A-A. Then adjust other bungee to bottom at the same place and install. (This step may be done with the springs removed.)

**3** Bend tab on the uplock hook to obtain 1/32 ( $\pm 1/32$ ) inch dimension shown in view A-A between roller and throat of the uplock hook.

**VIEW A-A**

FJ-48-2-56-5



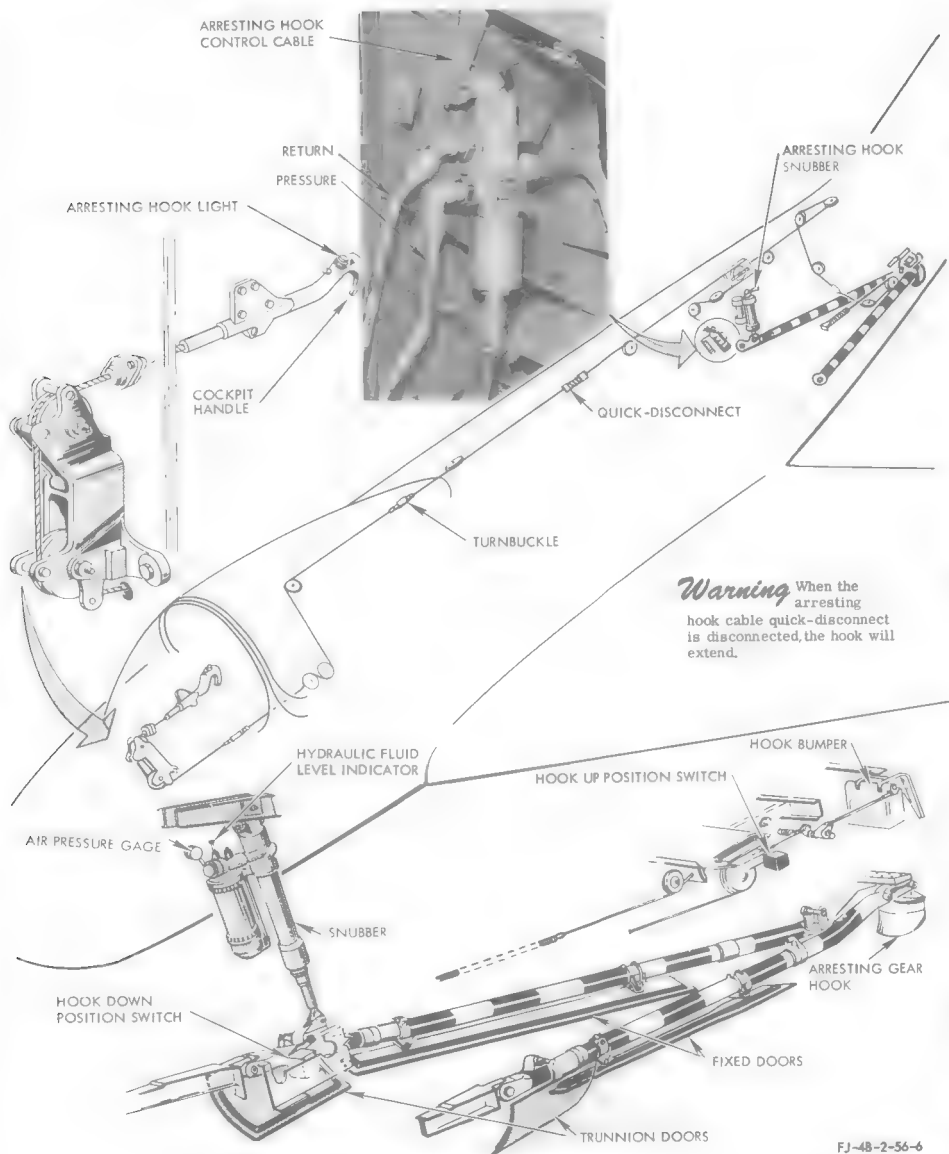


Figure No. 3-57. Arresting Gear System

**ARRESTING GEAR SYSTEM****3-305. ARRESTING GEAR SYSTEM.**

3-306. The arresting hook is located in the bottom aft fuselage. It is electrically controlled during the retract cycle and mechanically controlled during the extend cycle. Operation through both cycles is hydraulic. An air-oil snubber, attached to the right-hand tube aft of the hook trunnion, functions as a retract cylinder, an extend cylinder and a shock absorber. A pair of doors enclose the trunnions and are actuated by linkage from the hook tubes. Another set of doors are rigidly fastened to the hook tubes; they fair the hook except for the point which partially extends below the fuselage mold line. An uplock, operated by the control handle in the cockpit, holds the arresting hook in the retracted position. A warning light incorporated in the control handle illuminates when the hook is at an intermediate position. A bumper is provided to prevent the hook from fully retracting during an arrested landing. Should the release cable become severed when the control handle is in the "UP" position, the cable return spring will unlock the uplock. However, as the uplock unlocks, it closes the up indicating switch and energizes the selector valve. This directs hydraulic pressure to the retract side of the snubber cylinder and prevents the hook from extending. Subsequently, when the control handle is placed in the "DOWN" position, the selector valve will be closed, allowing the hook to extend in the normal manner.

**3-307. FUNCTION OF ARRESTING GEAR SYSTEM—EXTEND CYCLE.**

3-308. To extend the arresting hook, pull the control handle as far as possible, starting the following operations:

- a. The control handle actuates a switch to complete an electrical circuit from the primary 28-volt d-c bus through the warning light to ground via the hook down position switch. The warning light, located in the control handle, illuminates.
- b. The release cable unlocks the hook uplock. Hydraulic pressure in the snubber assists gravity in extending the hook.
- c. As the hook extends, a bumper actuating link rotates the bumper into position to prevent the hook from fully retracting in the event of hook bounce. As the hook

approaches the extended position, it is brought to a cushioned stop by the snubber.

- d. The hook actuates the down position switch, breaks the electrical circuit and causes the warning light to go out.

**3-309. FUNCTION OF ARRESTING GEAR SYSTEM—RETRACT CYCLE.**

3-310. To retract the arresting hook, rotate the control handle approximately 90 degrees counterclockwise.

**CAUTION**

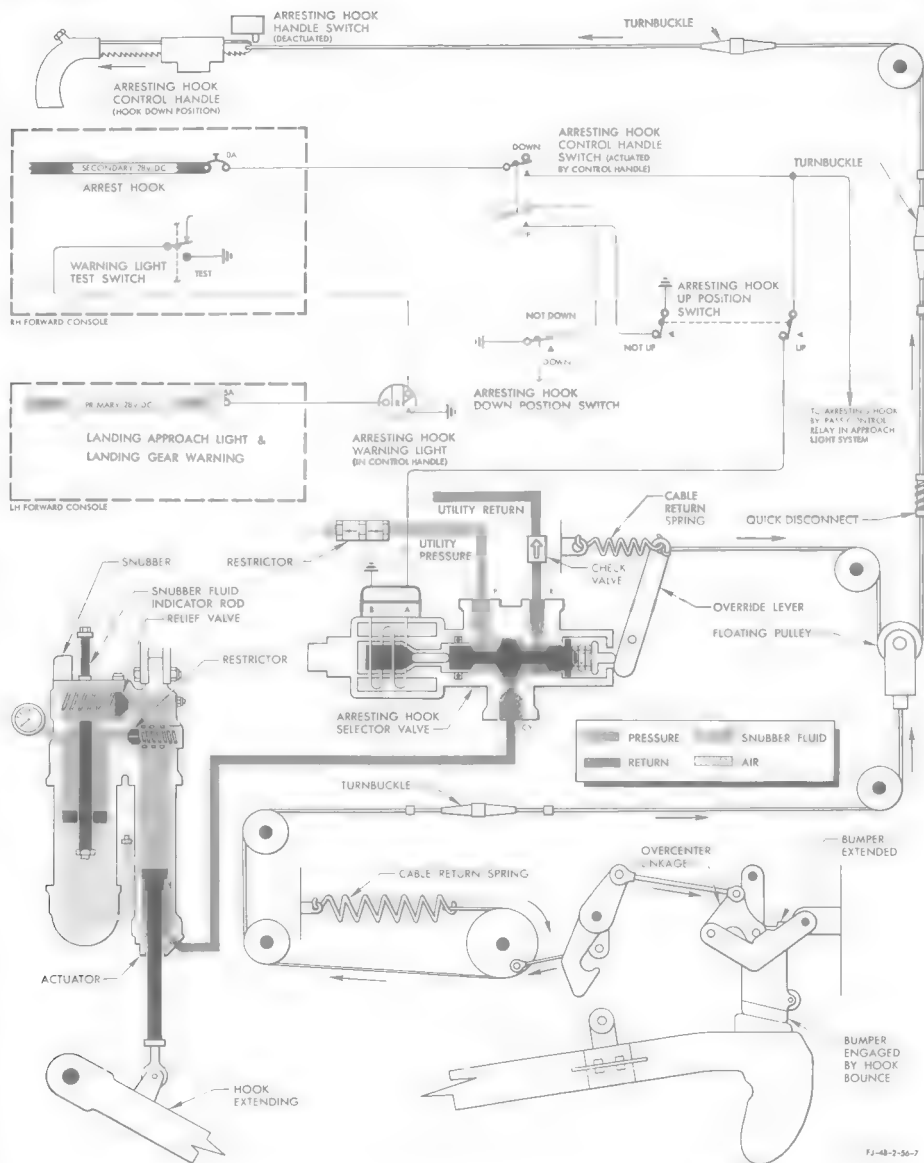
Do not rotate handle more than necessary. Excessive rotation will damage the warning light wiring insulation.

This allows the spring-loaded release cable to return the control handle to the "UP" position, starting the following operations:

- a. The control handle actuates a switch and completes an electrical circuit from the secondary 28-volt d-c bus through the up position switch to the selector valve. An electric circuit is also completed from the primary 28-volt d-c bus through the up position switch to illuminate the warning light.
- b. The selector valve override lever is released and allows utility hydraulic system pressure flow to the retract side of the snubber. The bumper is rotated to a partially retracted position.
- c. The lock actuating link, driven by a sector, positions the uplock to receive the hook roller.
- d. As the hook retracts, hydraulic fluid on the extend side of the snubber piston is forced through a restrictor and into the accumulator to compress the contained air.
- e. The hook roller cams open the uplock and, as the arresting hook reaches the retracted position, a torsion spring around the uplock shaft closes it against the roller.
- f. In the up and locked position, the arresting hook actuates the up position switch, causing the warning light to go out. The selector valve is de-energized and opens the retract port of the snubber to return.

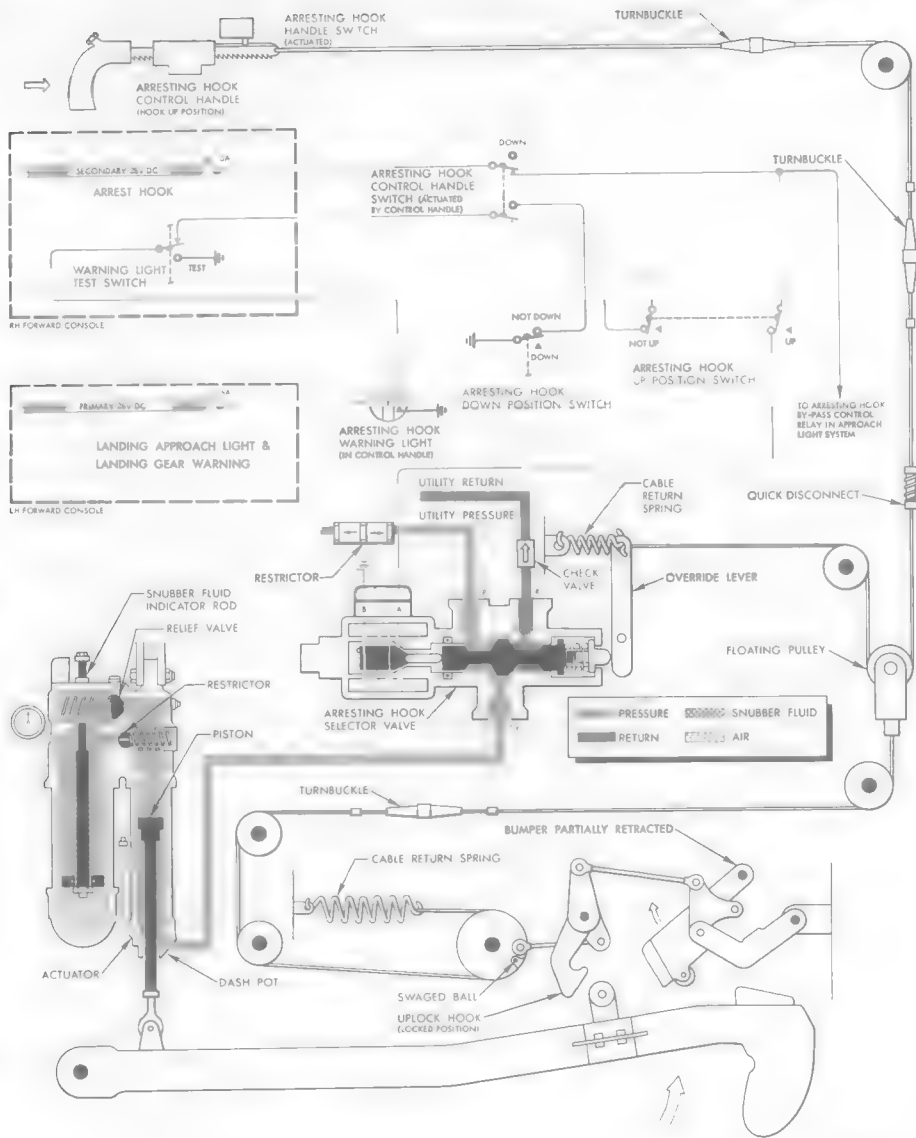
Section III  
Arresting Gear System

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FJ-48-7-56-7

Figure No. 3-58. Arresting Gear System Schematic—Hook Extending



FJ-48-2-56-8

Figure No. 3-59. Arresting Gear System Schematic—Hook Retracting

3-311. TROUBLE SHOOTING ARRESTING GEAR SYSTEM.

PROBABLE CAUSE	ISOLATION PROCEDURE	REMEDY
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**HOOK FAILS TO RETRACT.**

Defective selector valve.	Check for 28-volt d-c power to selector valve. If power is available at the solenoid of the valve and valve fails to function, the selector valve is malfunctioning.	Replace selector valve.
Defective control circuit.	Check for 28-volt d-c power at the selector valve, check circuit back to source of power for the malfunction and check for open or short in circuit or operating switch.	Replace or repair malfunction in circuit or switch.
Leaking "O" ring seals on snubber piston.	Unable to maintain a proper precharge in snubber.	Replace snubber assembly. (Refer to paragraph 3-326.)

**HOOK RETRACTS TOO SLOWLY.**

Excessive air precharge. Low utility hydraulic pressure. Leaking "O" ring seal in snubber piston.	Check utility system for 3000 psi pressure. Unable to maintain proper precharge in snubber.	Re-service snubber. (Refer to paragraph 3-327.) Replace snubber assembly. (Refer to paragraph 3-326.)
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**HOOK FAILS TO LOCK IN UP POSITION.**

Hook lock mechanism faulty.	Retract hook; hook fails to lock up.	Check hook release cable and hook uplock linkage and mechanism for adjustment. (Refer to paragraph 3-331.)
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**HOOK EXTENDS SLOWLY.**

Snubber not properly precharged.	Check servicing of snubber assembly.	Re-service snubber assembly. (Refer to paragraph 3-327.)
Selector valve restricting return flow.	Ensure snubber is operating properly.	Replace selector valve.

**IMPROPER SNUBBER ACTION.**

No air or insufficient air in snubber assembly.	Check for proper servicing.	Re-service snubber assembly. (Refer to paragraph 3-327.)
Defective snubber assembly.	Check for relief valve jammed in open position. Check for restrictor valve jammed in free flow position.	Replace snubber. (Refer to paragraph 3-326.)
Insufficient oil in snubber assembly.	Check for proper servicing.	Re-service snubber assembly. (Refer to paragraph 3-327.)

**HOOK WILL NOT RETRACT SUFFICIENTLY.**

Too much oil in snubber assembly.	Check for proper snubber servicing.	Re-service snubber assembly. (Refer to paragraph 3-327.)
Excessive air precharge.	Check for proper snubber servicing.	Re-service snubber assembly. (Refer to paragraph 3-327.)

PROBABLE CAUSE	ISOLATION PROCEDURE	METER READING	REMEDY
<b>POWER FAILURE.</b>			
Defective circuit breaker.	Check test point PBR to ground.	28 volts dc.	Replace circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.
	Check test point PDM to ground.	28 volts dc.	Replace circuit breaker.
		Zero volts.	Refer to paragraph 8-61, Trouble Shooting D-C Power Distribution System.
<b>HOOK RETRACTS SLOWLY.</b>			
Excessive air precharge in snubber.	Check snubber air pressure.		Service snubber. (Refer to paragraph 3-327.)
<b>HOOK FAILS TO LOCK IN UP POSITION.</b>			
Uplock not properly rigged.	Check uplock rigging.		Rig uplock. (Refer to paragraph 3-331.)
<b>HOOK BOUNCE.</b>			
Insufficient air or oil in snubber assembly.	Check for proper servicing.		Service snubber assembly. (Refer to paragraph 3-327.)
Defective snubber assembly.	Check for relief valve or restrictor malfunction.		Replace snubber assembly. (Refer to paragraph 3-326.)
<b>HOOK WILL NOT RETRACT COMPLETELY.</b>			
Too much air or oil in snubber assembly.	Check for proper servicing.		Service snubber assembly. (Refer to paragraph 3-327.)

## 3-312. CHECKING ARRESTING GEAR SYSTEM.

3-313. Prior to the following check, make sure snubber has been serviced and the utility hydraulic system is operating properly.

a. Connect external electrical and hydraulic power sources.

b. Place airplane on jacks so hook can free fall 60 11/16 inches from centerline of uplock to centerline of hook roller.

c. With arresting hook and landing gear retracted, set test stand for 4.0 gpm at 3000 psi; pull control handle. The warning light should illuminate while hook extends. When hook is partially extended, return control handle to retract position. The hook should immediately start retraction without going to the fully extended position.

d. With the arresting hook in the extended position, return control handle to retract. While the hook is retracting, the warning light should illuminate. When the hook is partially retracted, pull the control handle. The hook should immediately start extension without moving to the retracted position.

e. Hook retraction time should be approximately 1 1/2 seconds.

f. Fairing doors should be flush with mold line of fuselage when hydraulic pressure is off.

## 3-314. ARRESTING GEAR HOOK.

3-315. The arresting gear hook is a V type. It consists of two tubes with trunnions on one end and converges to an apex where the hook point is attached.

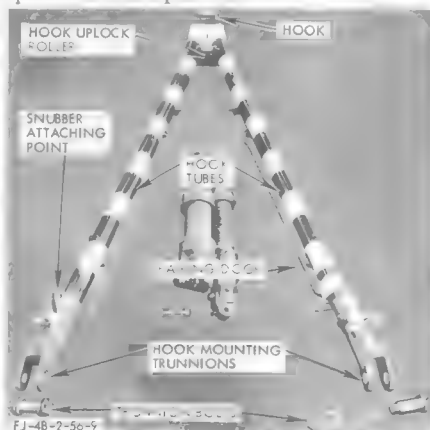
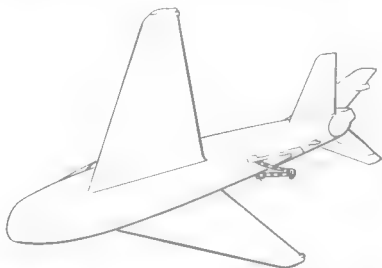


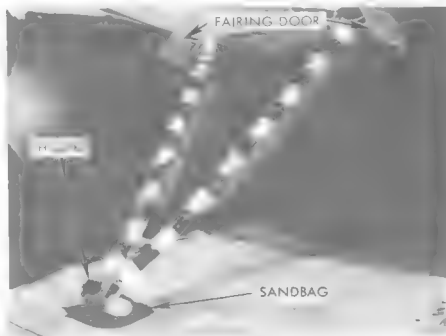
Figure No. 3-60. Arresting Gear Hook

### 3-316. REMOVING ARRESTING HOOK.

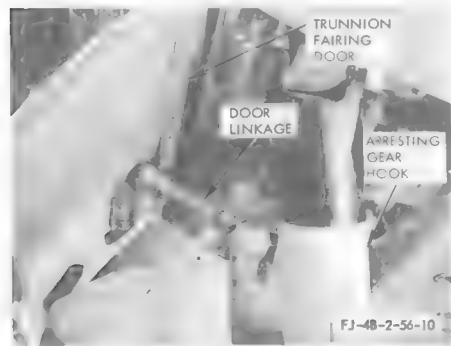


#### REMOVING

- 1** Place padding or sand bag on floor to prevent damage to hook; then extend the hook.



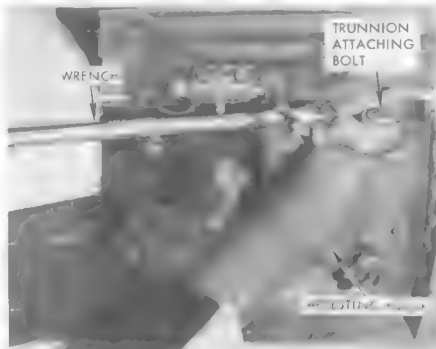
- 2** Remove the arresting hook trunnion fairing door linkage.



- 3** Remove bolt attaching arresting hook to snubber piston.



- 4** Remove arresting hook trunnion attaching bolts.



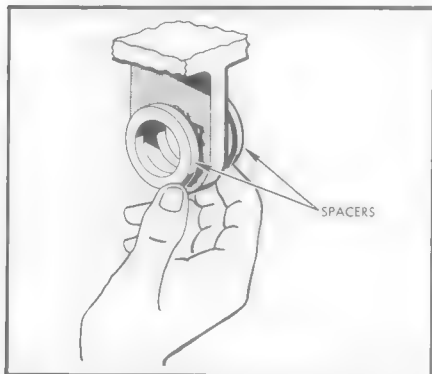
- 5** Pull arresting hook aft and down. Care should be taken not to damage the hook down indicating switch.





## 3-317. INSTALLING ARRESTING HOOK.

- 1** Place the bearing spacers on each side of the arresting gear attachment trunnion. Use ample grease to hold bearing spacers in place while fitting the hook in position.



- 2** Lift hook into position (at least three persons are required for this operation). Have one man hold the bearing spacers at each trunnion while hook is being positioned. (Be certain limit switch arm engages fitting on the hook.)

- 3** Install mounting bolts, washers and nuts.

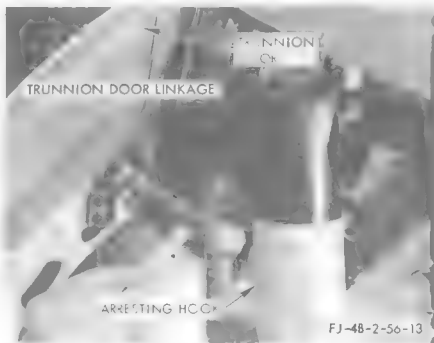


FJ-48-2-56-12

- 4** Connect the snubber cylinder piston rod to the hook fitting with grease fitting pointing aft.



- 5** Connect trunnion fairing door linkage. Adjust arresting hook and rig the control linkage. (Refer to paragraph 3-321.)



FJ-48-2-56-13

3-318. ARRESTING HOOK FAIRING DOORS.

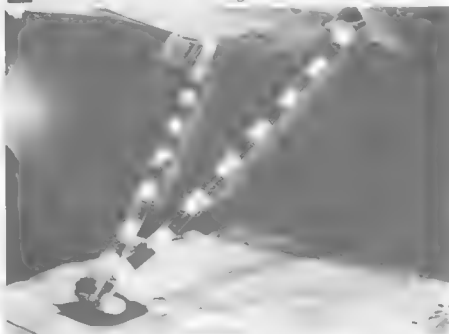
3-319. The arresting hook is faired by two sets of doors, except for the hook point which extends partially below the mold line of the fuselage. A pair of doors fair the trunnions and are actuated by links from the arresting hook. A set of fixed fairings are attached to the hook tubes.

3-320. REMOVING AND INSTALLING ARRESTING GEAR FAIRING DOORS.

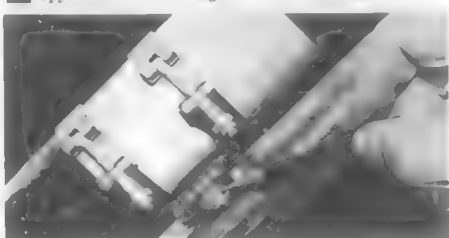
REMOVING

1 Extend the hook.

2 Remove the two lower mounting bolt nuts attaching the lower end of the fairing door to the hook tube.



3 Remove the upper mounting bolt nut attaching the upper end of the fairing door to the hook tube.



INSTALLING

1 Hold the hook tube fairing door in place and install the upper mounting bolt, nut and cotter pin. (Refer to removal step 3.)

2 Install the two lower mounting bolts and nuts. (Refer to removal step 2.)

3 For rigging and adjusting hook tube fairing doors, refer to paragraph 3-321.

REMOVING

1 Extend hook.

2 Disconnect links attaching trunnion fairing doors to hook tubes.



3 Disconnect bonding wire.

4 Remove screws holding trunnion fairing door hinge to fuselage.



INSTALLING

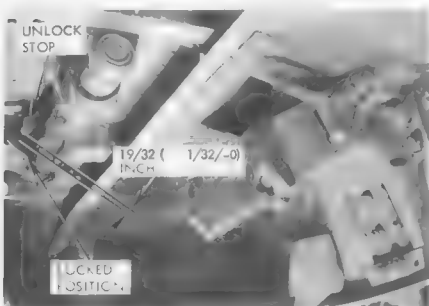
Reverse above procedure for installation.

## 3-321. RIGGING AND ADJUSTING ARRESTING HOOK AND FAIRING DOORS.

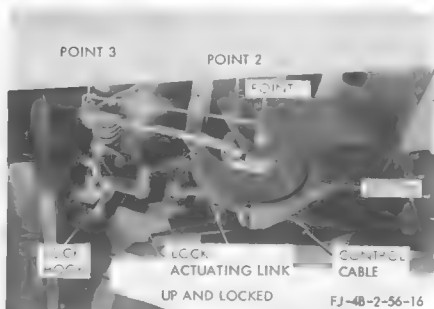
- 1** With control cable rigged to hold sector in locked position, insert No. 1 rig pin. (Refer to paragraph 3-331.)



- 2** Rotate lock mechanism toward the locked position to get 19/32-inch dimension shown.

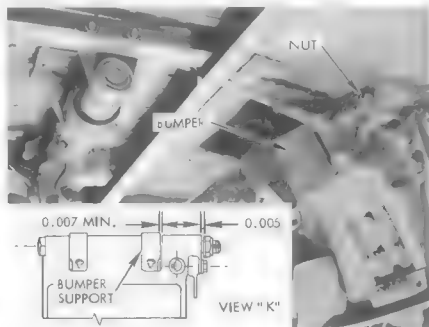


- 3** Adjust lock actuating link to fit between points 2 and 3. Make sure points 1, 2 and 3 form a straight line.

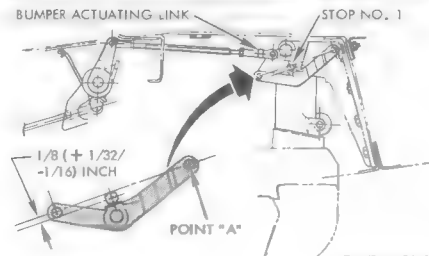
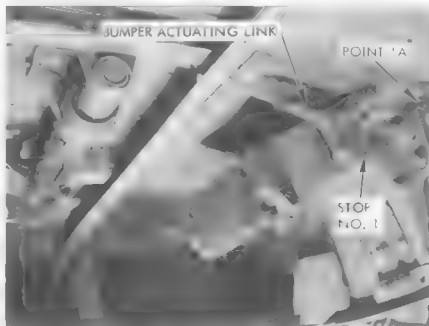


FJ-4B-2-56-16

- 4** Tighten nut to 0.005-inch clearance between washer and bumper as shown in view "K." Check for 0.007-inch minimum clearance between bumper and bumper support.

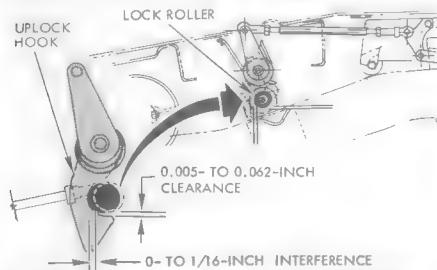


- 5** With bumper rotated down against bumper stop, adjust shims at point "A" so linkage will move freely until contact is made between links at stop No. 1. With stop No. 1 in contact, links must be overcenter 1/8 (+1/32/-1/16) inch. With hook latch mechanism unlocked and stop No. 1 in contact, adjust bumper actuating link to fit between attaching points; then lengthen four full turns (1/8 inch) and install.

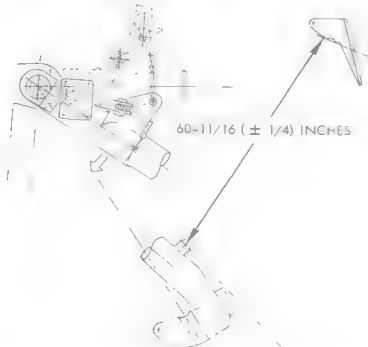


FJ-4B-2-56-17

- 6** With pressure off the snubber, retract the hook by hand until it is up and locked. Adjust hook mounted lock roller on its serrations to get 0.005- to 0.062-inch vertical clearance between roller and uplock hook. Adjust lock roller on its serrated mounting to get 0- to 1/16-inch horizontal interference between roller and uplock hook.



- 7** Adjust snubber rod end to get 60-11/16 ( $\pm 1/4$ ) inches from uplock roller to hook up-stop.



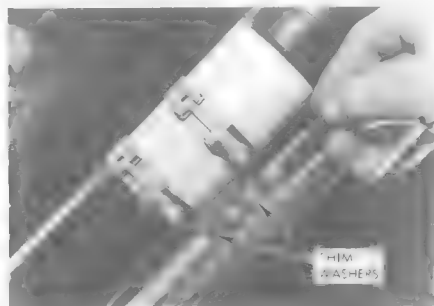
- 8** Trim edges of trunnion fairing door as required. Adjust actuating link to pull door up snug when hook is in retracted position.

**Caution** These links can be broken by overriggering. Disconnect links before removing snubber.

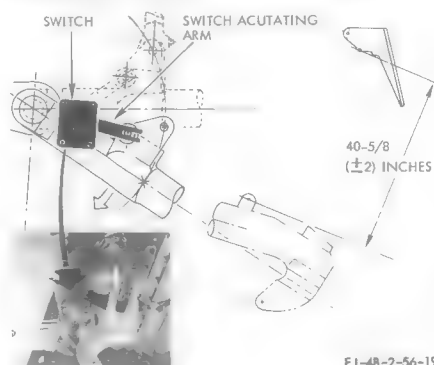
FJ-4B-2-56-18



- 9** Trim edges of tube fairing door as required. Use washers to fair doors when hook is in retracted position with pressure off.

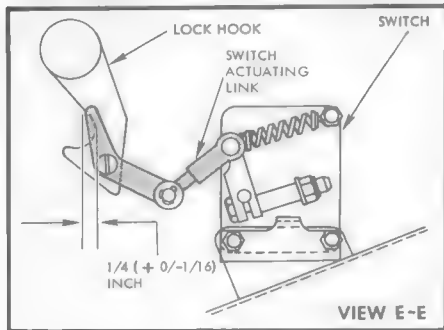
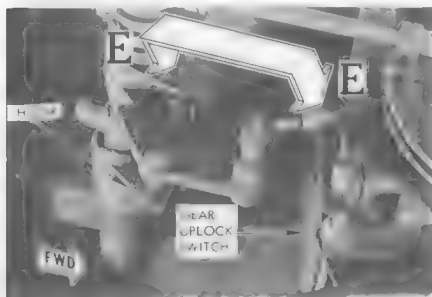


- 10** Hook down switch shall actuate at 40-5/8 ( $\pm 2$ ) inches. Adjust only if necessary; switch arm is preset. (Refer to paragraph 3-330.)



FJ-4B-2-56-19

- 11** With hook down and lock hook rotated aft to locked position, adjust switch actuating link to operate switch when trigger arm is  $1/4(+0/-1/16)$  inch from throat of hook.



- 12** Operate arresting gear several times and check for malfunctions.

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### 3-322. ARRESTING GEAR SELECTOR VALVE.

3-323. The selector valve contains a single solenoid and a movable spool. An override lever is mounted on the valve body. The valve has three ports: pressure, return and cylinder. Energizing the solenoid positions the spool for interconnection of the pressure and cylinder ports. When the solenoid is de-energized, or the override lever is actuated, the spool is repositioned, connecting the return and cylinder ports. The override lever ensures fluid flow from the cylinder into return if the spool sticks in



Figure No. 3-61. Arresting Gear Selector Valve

the cylinder pressure position or the solenoid malfunctions.

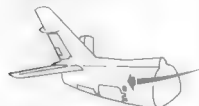
### 3-324. ARRESTING HOOK SNUBBER ASSEMBLY.

3-325. The arresting hook snubber assembly controls hook bounce during an arrested landing, provides a cushioned stop in the extended position and retracts the hook. It consists of an actuating cylinder with an attached accumulator. The fluid chamber of the accumulator is connected to the extend side of the actuator section. The connecting passage contains a one-way restrictor and a relief valve. Flow from the actuator to the accumulator is restricted. If pressure exceeds approximately 750 psi, the relief valve allows fluid to by-pass the restrictor. When the actuating piston retracts, the accumulator piston is forced down until it engages a nut on the indicator rod; further travel of the piston forces the rod down. The position of the rod with respect to an index on top of the accumulator is used to check fluid level (with the arresting hook retracted). The indicator rod is forced up by air pressure when the actuating piston extends. An air valve and pressure gage are provided for servicing. Air pressure should be approximately 500 psi when the actuating piston is fully retracted. Bleeder valves are provided for the actuator and accumulator sections. The accumulator bleed port is used for filling both sections with fluid (item 95, materials list). The actuating cylinder contains a dashpot on the retract side which causes the last 2 inches of extend travel to be snubbed.

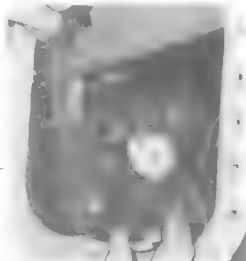
### 3-326. REMOVING AND INSTALLING ARRESTING GEAR SNUBBER.

#### REMOVING

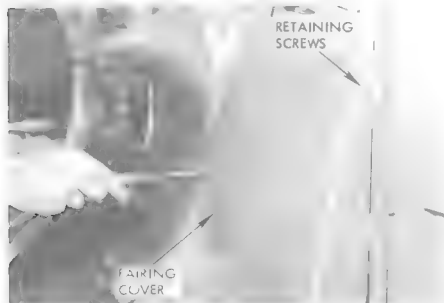
- 1 Remove fuselage aft section. (Refer to paragraph 2-6.)



- 2 Bleed snubber of air. (Refer to paragraph 3-327.)

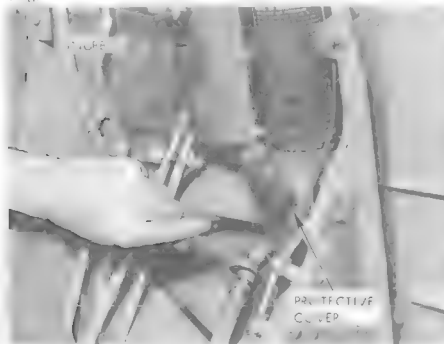


- 3 Remove snubber fairing.



- 4 Remove the arresting hook trunnion fairing doors.

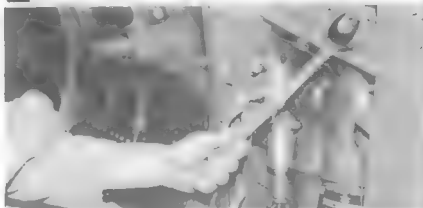
- 5 Remove hydraulic pressure line from bottom of snubber. Remove retaining nut and 45-degree fitting.



- 6 Manually lift arresting gear up and down several times to relieve pressure and tension on mounting bolts.

FJ-48-2-56-22

- 7 Remove the upper mounting bolt.



- 8 Remove bolt attaching piston rod to arresting hook.



- 9 Push piston rod into snubber cylinder until it hits the stop.

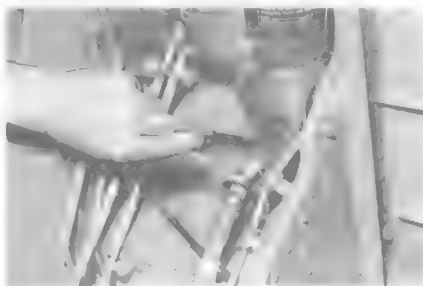
- 10 Withdraw snubber cylinder from fuselage being careful not to tear the cloth dust cover.

#### INSTALLING

- 1 Install snubber cylinder in position and attach the upper mounting bolt.

- 2 Pull piston rod out of snubber cylinder until the rod end can be attached to arresting hook attachment.

- 3 Install 45-degree fitting and retaining nut; then, attach hydraulic line.



- 4 Install the arresting hook trunnion fairing doors.

- 5 Install the snubber cylinder cover.

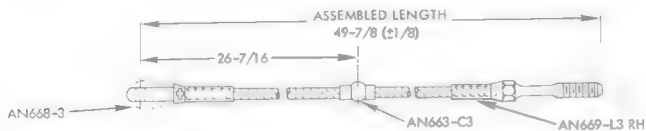
- 6 Service snubber. Refer to paragraph 3-327.)

FJ-48-2-56-23



CODE	PART NUMBER	PART NUMBER	ASSEMBLED LENGTH	DIAMETER	TYPE
A	RA2487-3	AN669-L3 LH	37-3/4 ( $\pm 1/8$ )	3/32	CARBON STEEL 7 x 7
B	AN669-L3 RH	AN669-53 LH	117-5/16 ( $\pm 1/8$ )	3/32	CARBON STEEL 7 x 7
C	AN663-C3	AN669-53 RH	27 ( $\pm 1/8$ )	3/32	CARBON STEEL 7 x 7
D	AN663-C3	AN667-3	106-1/2 ( $\pm 1/8$ )	3/32	CARBON STEEL 7 x 7
E	209-56766 AN664-C3	AN669-L3 RH	73-3/4 ( $\pm 1/8$ )	3/32	CARBON STEEL 7 x 7
F*	AN668-3 AN663-C3	AN669-L3 RH	49-7/8 ( $\pm 1/8$ )	3/32	CARBON STEEL 7 x 7

\* Detail Cable F

**Caution** Cables should not be fabricated unless testing facilities are available.

ALL DIMENSIONS ARE GIVEN IN INCHES

CODE	PART NUMBER	NAME
G	AN155-16L	BARREL
H	AN155-16S	BARREL

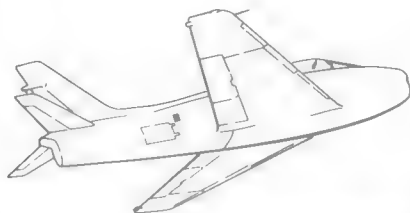
CODE	PART NUMBER	NAME
J	RA2258-3	TRULOC DISCONNECT
K	AN155-16L	BARREL

FJ-48-2-56-29A

Figure No. 3-62. Arresting Gear Control Cable Fabrication



3-327. SERVICING ARRESTING GEAR SNUBBER.



*Note*

- Service snubber with hook in retracted position.
- Use hydraulic fluid (Item 95, materials list).

**1** Remove screws from bleeder valves "A" and "B." Remove cap from high-pressure air valve. (For charging and discharging air through high-pressure air valves, refer to paragraph 1-39.)

**2** Release air pressure through air filler valve.

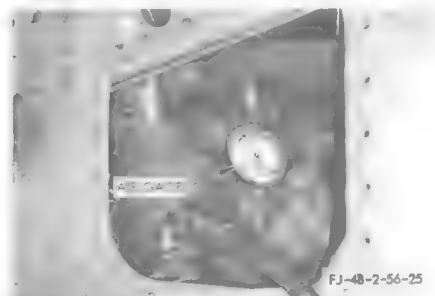
**3** With valve "B" closed, open valve "A" and connect fluid supply unit.



**4** Fill with fluid under pressure (500 psi maximum) until oil level indicator is lowered to approximately one inch below top of guide.



**5** Close valve "A," connect compressed air or dry nitrogen source to air filler valve and inflate snubber to approximately 100 psi. Oil level indicator will be fully extended.



FJ-48-2-56-25

FJ-48-2-56-24

- 6** Open valve "B" and bleed until free of air bubbles.

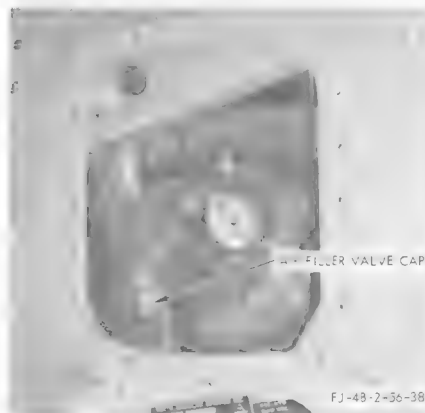
*Note* If necessary, repeat previous steps until air-free fluid is flowing from valve "B."

- 7** Close valve "B." Open valve "A" and bleed until fluid is free of air. Continue to bleed through valve "A" until oil level indicator is lowered to full position (flush with top of guide).



- 8** Close valve "A" and replace bleeder screws.

- 9** Inflate to 500 psi air pressure through air filler valve and then replace air filler valve cap.



### 3-328. ARRESTING HOOK POSITION INDICATING SYSTEM.

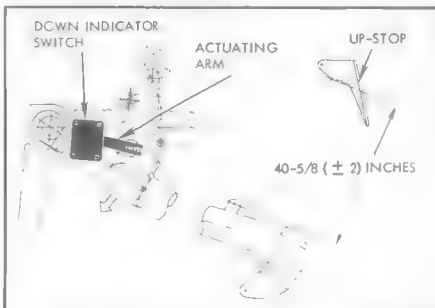
3-329. A warning light is mounted in the arresting hook control handle. Pulling the control handle out illuminates the light and unlocks the hook. As the hook reaches the down position, a switch causes the light to go out. Returning the control handle to the up position again illuminates the warning light. When the hook is locked up, another switch causes the light to go out and de-energizes the selector valve. Whenever the arresting hook is not in the position indicated by the control handle, the warning light illuminates.

### 3-330. INSTALLING AND ADJUSTING ARRESTING GEAR INDICATING SWITCHES.

#### DOWN INDICATOR SWITCH

Before installing in airplane, bench-adjust switch to actuate at 11 degrees when moved in direction indicated.

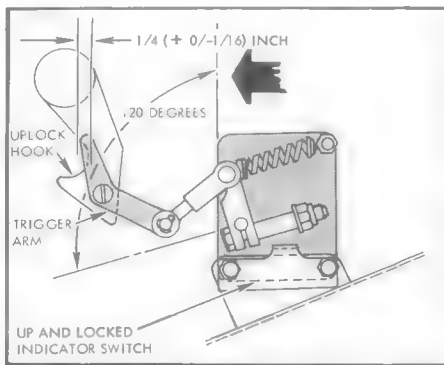
After installation, ensure that switch actuates when unlock roller is 40-5/8 (±2) inches from hook up-stop.



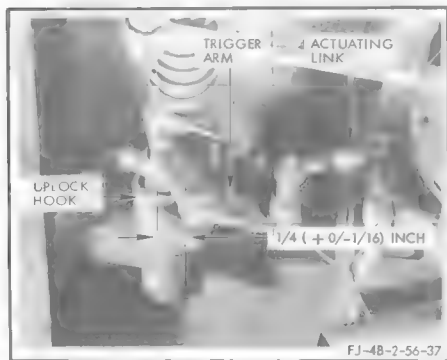
FJ-4B-2-56-26

UP AND LOCKED INDICATOR SWITCH

Before installing in airplane, bench-adjust switch to actuate at 120 degrees when moved in direction shown.



After installation, adjust actuating link to operate switch when trigger arm is  $1/4 (+0/-1/16)$  inch from throat of hook.



3-331. RIGGING AND ADJUSTING ARRESTING GEAR CONTROL CABLES.

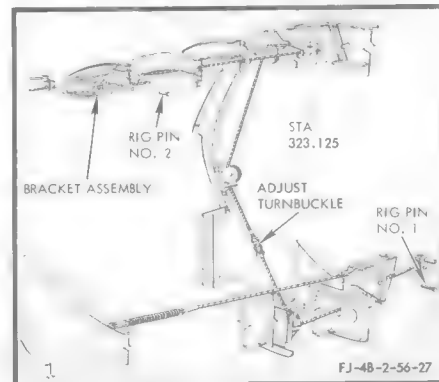
- 1 Set cockpit handle to full "IN" position.



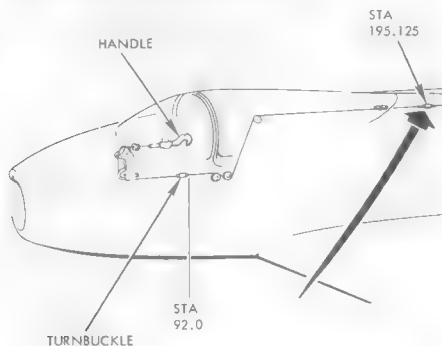
- 2 Insert rig pin No. 1 in sector and install spring to 23-pounds tension.



- 3 Insert rig pin No. 2 in bracket assembly and adjust turnbuckle at station 323.25 until no movement is obtained when rig pin No. 1 is removed. Safety turnbuckle.



- 4** Adjust turnbuckles at stations 92 and 195.125 until no movement is obtained when rig pin No. 2 is removed from bracket assembly.



- 5** Re-check all of the preceding items to ensure that their positions have not changed.
- 6** Safety-wire ball in sector drum and all turnbuckles.
- 7** Maximum pull at handle to be 55 pounds.

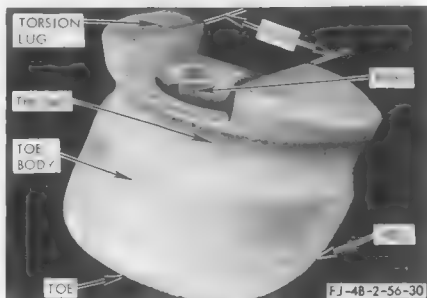
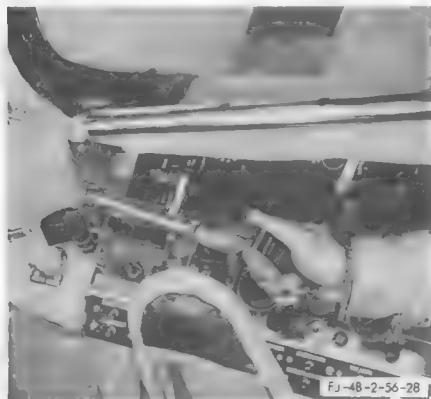


Figure No. 3-63. Detachable Arresting Gear Hook Point—Nomenclature

### 3-332. DETACHABLE ARRESTING GEAR HOOK POINTS.

3-333. Type IIB, annealed, detachable, forged steel arresting gear hook points normally exhibit numerous minute or hairline cracks in the Colmonoy coated surface, caused by cooling during manufacture of the point. This type of deformation is not considered detrimental to the hook point. However, use of the hook point will cause stretching of the throat metal which, in turn, will increase the prominence of the cracks. If the cracks are less than 1/64 inch in width, the hook point is still serviceable, provided the cracks do not extend into, or through, the base metal (figure 3-64). A solution of copper sulphate may be used to determine the depth of the cracks. Paint the copper sulphate solution along the Colmonoy steel edge of the slot. Copper will deposit on steel but not on Colmonoy; thus, if the crack does not appear on the coppered surface, it has not penetrated into the steel base metal. If any flaws exist in the bond between the Colmonoy coating and the steel base metal, segments of the coating will chip off at the first cable engagement. These chips, which have regular sides, comparatively smooth bottoms and are the full depth of the coating

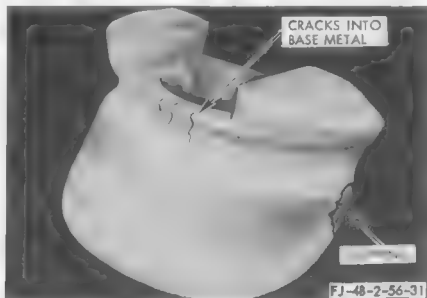
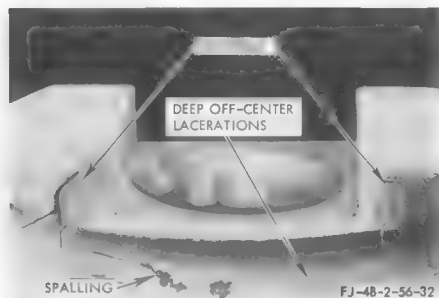
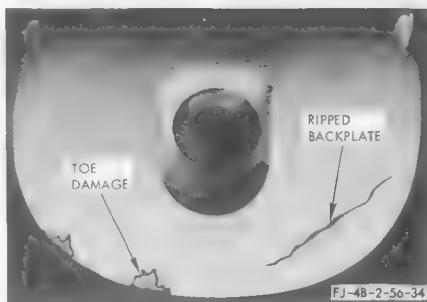


Figure No. 3-64. Cracks Into Base Metal—Chipping Due to Impact Loads



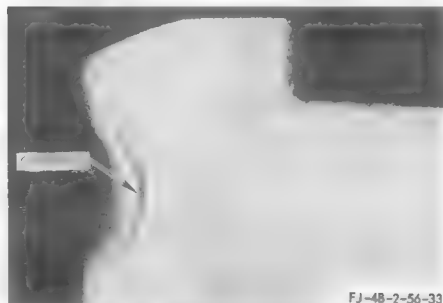
**Figure No. 3-65. Chipping Due to Faulty Bonding Spalling—Deep Off-center Lacerations**

(figure 3-65), are sufficient cause for discarding the hook point. Chipping should not be confused with spalling which does not disqualify the hook point for additional use. Figure 3-65 shows the irregular boundaries, rough bottom and shallow depth of a spalled area in the hook point cable groove. The annealing process may cause the Colmonoy coating to separate from the base metal (figure 3-66). This is a normal occurrence and does not affect the integrity of the Colmonoy coating on the remainder of the hook point. Hook points should not be discarded for this reason. Due to impact loads, chipping may occur at the extreme aft end of the cable groove (figure 3-64). This chipping is in an area not normally in contact with the cross-deck pendant during runout as indicated by the cable marks on the cable groove which stop short of the chipped area. Hook points, chipped in this manner, should be ground down to remove the sharp edges and returned to service. Toe damage (figure 3-67), caused by the hook point striking a protrusion on the deck, is a valid cause for discarding the hook point. Toe damage generally results in distortion of the backplate. Backplate damage may occur independent of toe

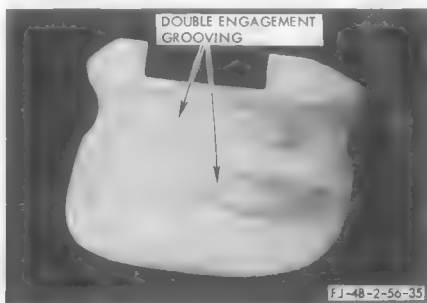


**Figure No. 3-67. Ripped Backplate—Toe Damage**

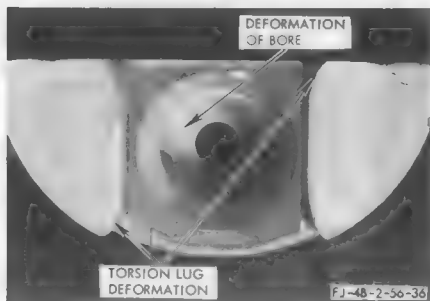
damage. Damage may range from cracks in or adjacent to welding or to extensive tearing and distortion (figure 3-67). If the damage is minor, the hook point need not be discarded; however, if the damage is such that the attaching bolthead will be exposed or the backplate will be prone to foul with any deck protrusion, the hook point should be discarded. A hook point should always be discarded if a double engagement occurs (figure 3-68). This type of engagement is easily recognized by grooving of the toe body. The engagement results in severe bending loads on the shank boss, causing deformation of the hook point bore (figure 3-69). However, deformation of the bore alone, if not more than 0.020 inch out of round, does not require that the hook point be discarded. Deformation of the torsion lugs exceeding a 0.060-inch total width of slot [measured at any point in the slot within  $\frac{3}{4}$  inch of either side of the bore centerline (figure 3-69)] is cause for discarding the hook point. This type of deformation is usually associated with a severe off-center engagement which also may cause deep, off-center lacerations in the cable groove (figure 3-65), leaving the throat section discolored and



**Figure No. 3-66. Gapping at End of Cable Groove Due to Annealing**



**Figure No. 3-68. Double Engagement Grooving**



**Figure No. 3-69. Deformation of Torsion Lugs and Bars**

severely ridged. Extremely high ridges may damage, if not sever, the cross-deck pendant on future engagements. Therefore, such hook points should be discarded. No attempt should be made locally to repair discarded Type IIB hook points. Discarded hook points should be

scrapped. In general, Colmonoy surfaced hook points should be handled as follows:

- a. Visually inspect, where practicable, after each landing for obvious defects. Damage may be incurred which, if undetected, may result in hook point failure on subsequent landings.
- b. Remove and examine for cracks in the shank slot after every 10 landings whenever operations permit.
- c. Scrap when subjected to a double wire engagement or observed to hit the ramp or a deck protrusion. Loose hook points increase the possibility of attaching bolt or nut failure, in addition to aggravating the chipping of Colmonoy coated hook points.

The following precautions should be taken in installing and inspecting points:

- a. Use a new attaching bolt and nut each time a hook point is removed and installed.
- b. Ensure that the hook point attaching bolt is properly installed (i.e., the threaded end of the bolt must be on top of the shank head forging).
- c. Ensure that the hook point is tightly secured on installations which utilize a fiber or nylon insert-type attaching nut; replace the nut if tightening is necessary.





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